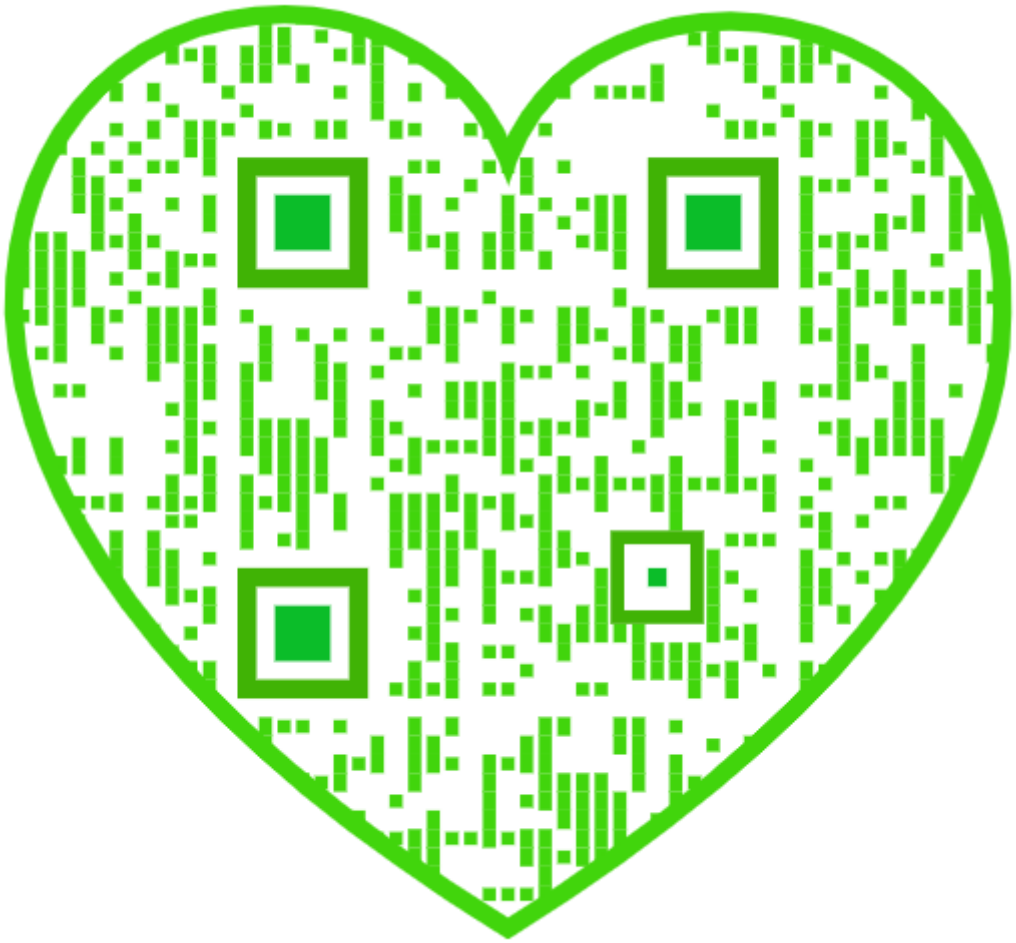

The Correspondence College of Agriculture

CORN—PART ONE

THE

Correspondence College *of* Agriculture

CORN—Part I

History, Types and Varieties of Corn

By HARRY B. POTTER, B. S.

Assistant Professor of Farm Crops
in Iowa State College

This is the First of a Series of Four Books giving a Complete Course of Instruction on Corn.

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The CORRESPONDENCE COLLEGE OF AGRICULTURE

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NOTE TO STUDENTS

In order to derive the utmost possible benefit from this paper, you must thoroughly master the text. While it is not intended that you commit the exact words of the text to memory, still there is nothing contained in the text which is not absolutely essential for the intelligent corn grower to know. For your own good never refer to the examination questions until you have finished your study of the text. By following this plan, the examination paper will show what you have learned from the text.

Part I—CORN

INTRODUCTION.

The study of a crop, such as corn has become, involves a consideration of many complex, yet interesting, items which include figures, facts and ideas. In the case where figures are involved to any great extent we generally have a study which might be classed as economics. Where facts are a part of our work there are features of agricultural progress emphasized by accurate data secured, as a rule, by some experiment station. Classed under ideas are those generally accepted opinions which in most cases are both practical and practicable, and yet which have never been made a matter of definite experimentation for the purpose of ascertaining to what extent, if at all, they are really money-making schemes. In other words, we have had ideas for many years as to how corn should be treated. The Indians had ideas before we did. Some of these ideas, as the years of agricultural development passed, were placed under the perfect control of experienced men. As a result of their work, which took place (as has been said) usually on experimental farms, there exist today certain facts which will stand the test of the most careful critic. As a result of this transition from ideas to facts there has been a history laid down which shows where corn has traveled in its course, why it has developed in certain well defined sections to such an extent, why the development in two sections has not been the same, nor like the change in any other section. These matters of history are given to us more or less in figures, all of which point to the development of one of the greatest world crops.

MAR 31 1914

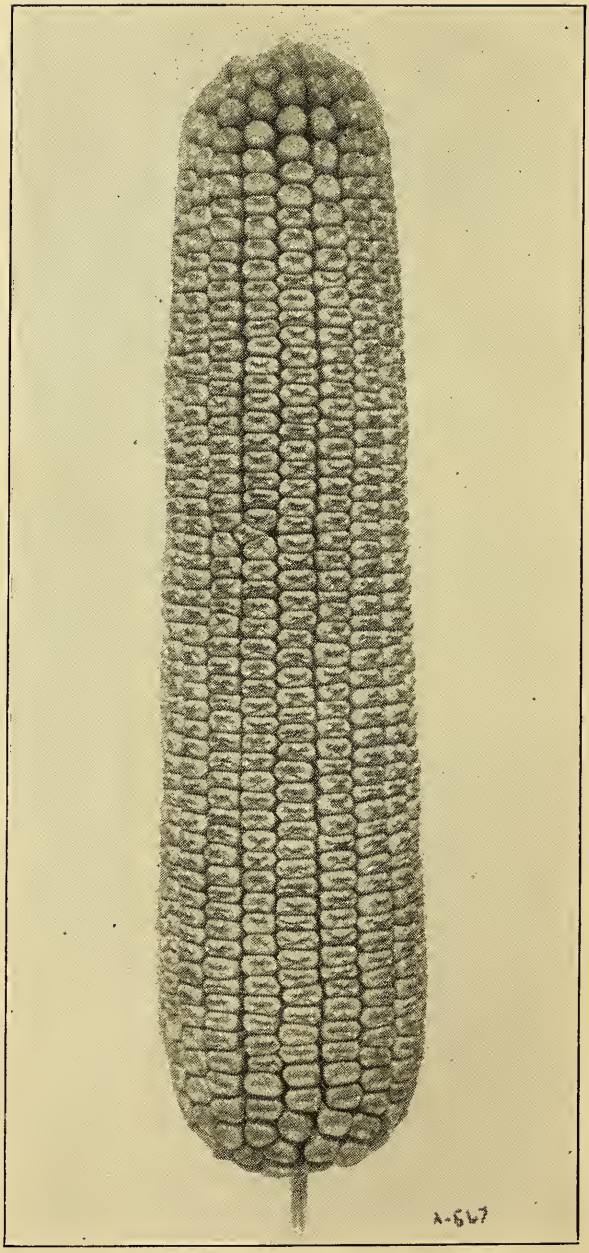


PLATE I—A Good Ear of Corn
This is an ear of Reid's Yellow Dent and shows remarkable uniformity.—Iowa State College.

Corn as a World Crop.

No one doubts the place of corn as a world crop. Every nation has been raising it for years past, and as the history of agriculture advances there seems to be a greater eagerness on the part of all to participate in the raising of corn, our greatest cereal. A comparison of the years 1904-1908 will show how all nations are concerned. The following table gives for the above years the total yield in million bushels for each continent:

	1904	1905	1906	1907	1908
Europe	304	440	608	490	528
North America	2,576	2,812	3,021	2,686	2,762
South America	180	146	199	79	143
Australasia	11	9	9	11	9
Africa	39	38	38	42	37
Total	3,110	3,445	3,875	3,308	3,479

This table brings out the importance of corn as a whole crop, since the annual yield is around three and one-half billion bushels, on an area of about one hundred and thirty-five million acres.

The following table gives, for the continents, the amount of land under corn for years 1904-1908, in million acres:

	1904	1905	1906	1907	1908
Europe	24	24	25	26	25
North America	93	94	97	100	102
South America	5	6	7	8	7
Australasia	.3	.3	.3	.3	.3
Africa	2	2	2	2	2
Total	124.3	126.3	131.3	136.3	136.3

North America stands out from among all of the rest in acreage and yield. Likewise the United States of all the North American countries is the one where corn is most popular.

Rank of the United States.

The table below shows how the United States ranks in yield. If acreage were given, the same general ratio of countries would be shown. Figures are given in million bushels:

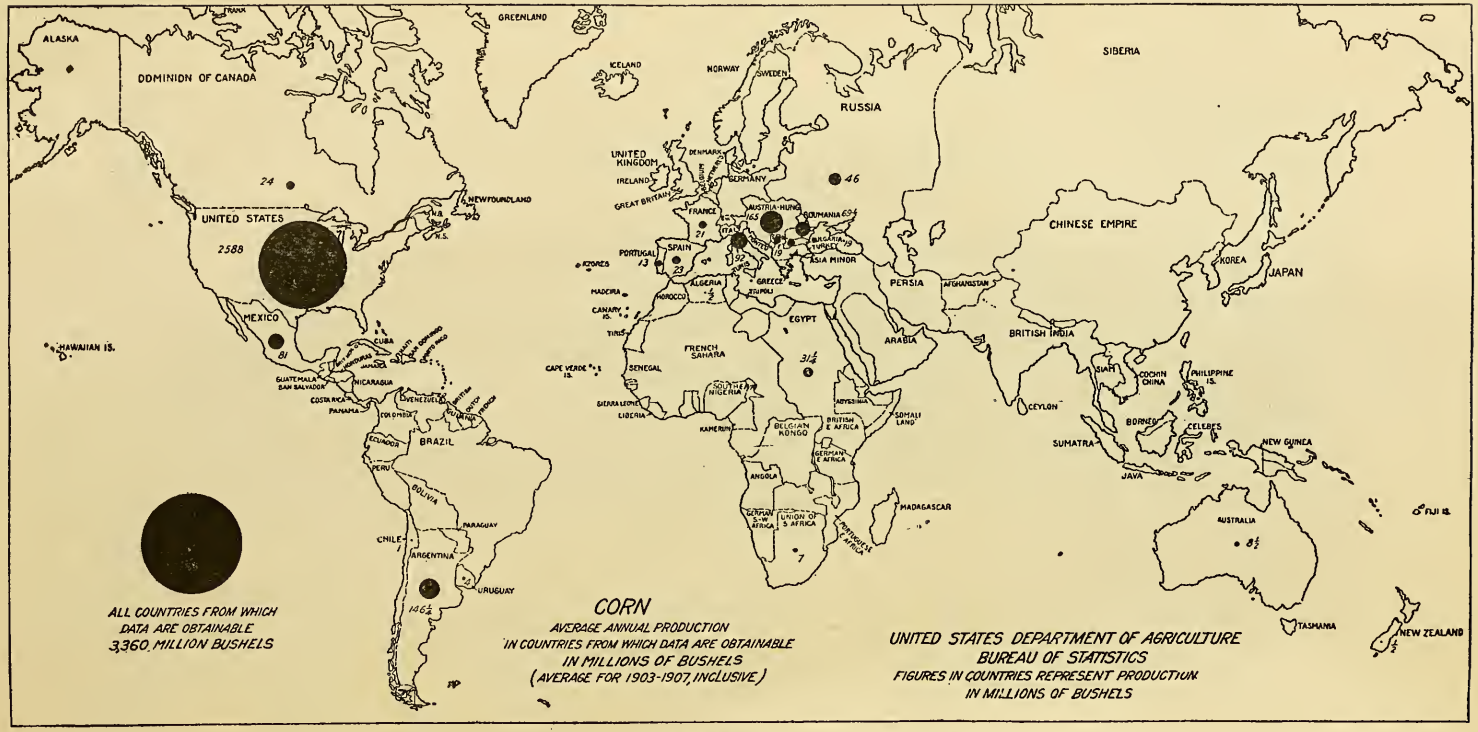
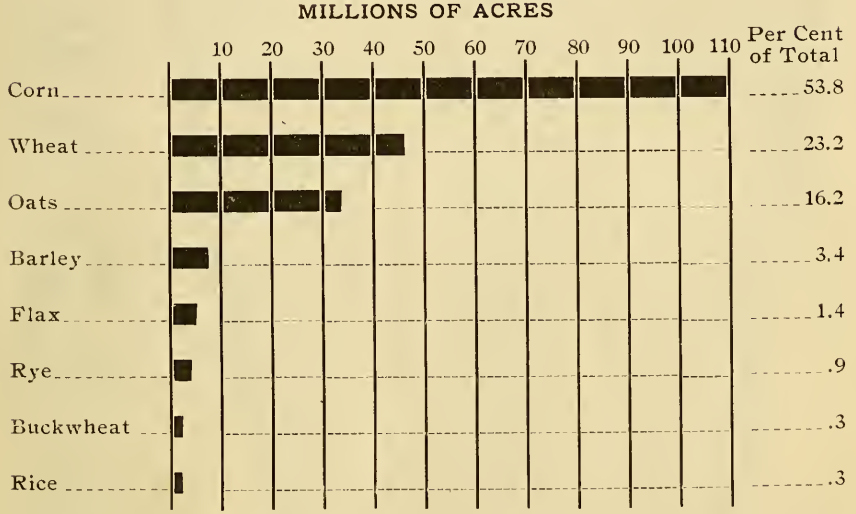

ALASKA
DOMINION OF CANADA
GREENLAND
ICELAND
NORWAY
SWEDEN
RUSSIA
SIBERIA
UNITED KINGDOM
IRELAND
GREAT BRITAIN
DENMARK
GERMANY
FRANCE
AUSTRIA-HUNG.
ROUMANIA
BULGARIA
TURKEY
ASIA MINOR
PORTUGAL
SPAIN
AZORES
MADEIRA
CANARY IS.
ALGERIA
MOROCCO
TRIPOLI
GREECE
TUNIS
EGYPT
PERSIA
AFGHANISTAN
ARABIA
CHINESE EMPIRE
KOREA
JAPAN
BRITISH INDIA
SIAM
COCHIN CHINA
PHILIPPINE IS.
CEYLON
BORNEO
CELEBES
SUMATRA
JAVA
NEW GUINEA
FIJI IS.
AUSTRALIA
TASMANIA
NEW ZEALAND
UNITED STATES
NEWFOUNDLAND
N.S.
MEXICO
HAWAIIAN IS.
CUBA
JAMAICA
HONDURAS
GUATEMALA
SAN SALVADOR
NICARAGUA
COSTA RICA
PANAMA
VENEZUELA
COLOMBIA
BRITISH GUIANA
DUTCH GUIANA
ECUADOR
PERU
BRAZIL
BOLIVIA
PARAGUAY
CHILE
ARGENTINA
URUGUAY
FRENCH SAHARA
SENEGAL
CAPE VERDE IS.
SIERRA LEONE
LIBERIA
NIGERIA
KAMERUN
BELGIAN CONGO
ANGOLA
ABYSSINIA
BRITISH E. AFRICA
SOMALI LAND
GERMAN E. AFRICA
MADAGASCAR
GERMAN S.W. AFRICA
UNION OF S. AFRICA
PORTUGUESE AFRICA
2588
81
24
46
21
13
22
4
3½
7
8½
162½
ALL COUNTRIES FROM WHICH DATA ARE OBTAINABLE 3,360 MILLION BUSHELS
CORN
AVERAGE ANNUAL PRODUCTION IN COUNTRIES FROM WHICH DATA ARE OBTAINABLE IN MILLIONS OF BUSHELS (AVERAGE FOR 1903-1907, INCLUSIVE)
UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF STATISTICS
FIGURES IN COUNTRIES REPRESENT PRODUCTION IN MILLIONS OF BUSHELS

CHART I

	1904	1905	1906	1907	1908
United States	2,468	2,708	2,927	2,593	2,669
Canada	20	21	24	23	23
Mexico	88	83	70	70	70

CHART II

Comparative Acreage of all Cereals in the United States, 1909



With these figures before us, the importance of corn as a crop among all nations is very evident, and when we consider that seventy-five per cent. of the crop of the world is raised in North America and ninety per cent. of the corn of North America is raised in the United States, it is also evident that the United States has a great responsibility as an example for other nations. It is not to be wondered then that we will find in some of the newspapers of worth such statements as these: "Imagine if you can what a corn crop of 3,121,391,000 bushels for this year with reserve holdings amounting to 119,056,000 bushels means to this country. The Agricultural Department Report, issued Wednesday, is astounding. It simply runs ahead of our fondest hopes and establishes the farms of America as greater than ever the productive basis of real prosperity. Three billion bushels of

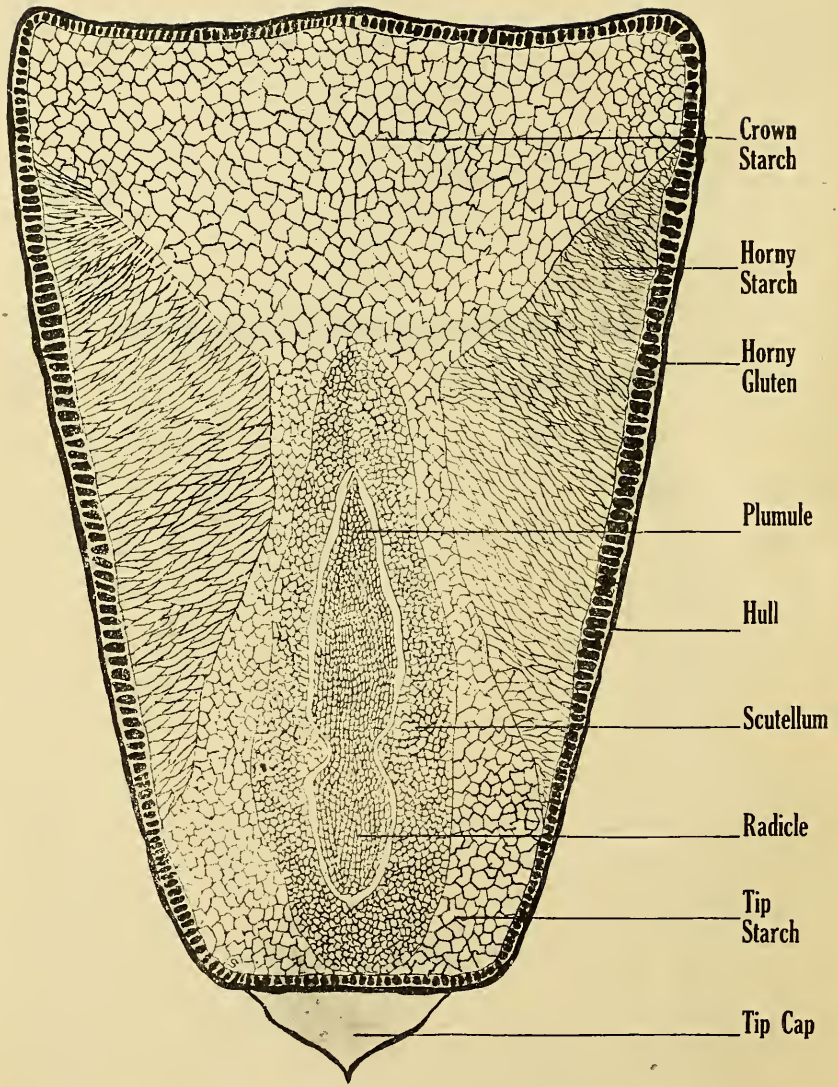


PLATE 2—THE PHYSICAL PARTS OF THE CORN KERNEL

Represents a longitudinal section of the kernel, germ laid bare.—*Bowman and Crossley.*

corn is equivalent to a per capita distribution of thirty-five bushels for each person in America. The country's prosperity is assured by this new record crop. It may be a more general prosperity where the increased volume will more than offset the high net returns of recent years, when a smaller crop sold at a greater price per bushel."

In other words, this enormous yield of corn in the United States will mean more dollars in the pockets of more people than ever before. Chart I. brings out graphically the relation of this corn crop to the continents of this world and indicates very clearly where the United States stands as a corn growing nation.

Corn Among other Cereals.

But it is not sufficient to consider the United States and the corn crop alone. If we take the comparative acreage of the cereals as shown by Chart II., we get a graphic representation of the value of corn among the other cereals raised in the United States. The average person fails to realize the importance of the corn crop; especially if he lives in a wheat-growing section.

TABLE I.

Acreage of Corn as Compared with Total Acreage of All Farm Land in Each of the Ten Leading States in Its Production in 1900.

State.	Acres of Farm Land.	Acres in Corn.	Per Cent.
Illinois	32,794,728	7,139,898	21.8
Iowa	34,574,337	8,048,946	23.3
Missouri	33,997,873	6,453,943	18.9
Nebraska	29,911,779	8,093,464	27.1
Indiana	21,619,623	4,031,600	19.1
Texas	125,807,017	4,553,495	3.6
Kansas	41,662,970	8,624,770	20.7
Ohio	24,501,985	2,888,924	11.8
Oklahoma	15,719,258	544,000	3.5
Kentucky	21,979,422	2,664,124	12.1

CHART III

Production of Corn in the Ten Leading States, 1909

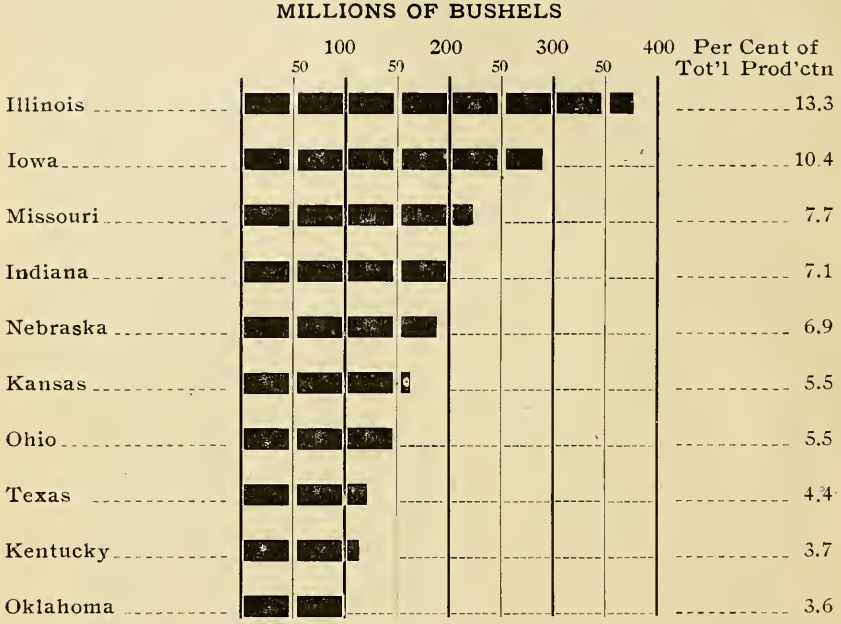


TABLE II.

Production and Population.

Year.	Population.	Total Production in U. S. (bushels)	Corn per Capita (bus.)
1850	23,191,876	592,071,104	25.5
1860	31,443,321	838,792,742	26.6
1870	38,558,471	760,944,549	19.7
1880	50,155,783	1,754,591,676	34.9
1890	62,622,190	2,122,327,547	33.8
1900	75,997,873	2,666,440,279	35.0

Prominent Corn-Growing States.

As the United States, then, is the first among all nations in the production of corn, it is only natural to turn to the states which make this fact true. In Table I. will be noted some facts regarding the ten leading states in corn production in 1900. It is not always fair to consider one fact alone, but when it is realized that a state is willing to devote a high percentage of farm lands to corn, the state must be considered a corn-producing one. The figures given are for the year 1900, and while those figures are not changing particularly for some of the highest states, they are materially changing for a great many of the states not now among the so-called corn belt. Chart III. represents the common way of comparing states; namely, by taking the total production of each state, regardless of the amount of land devoted to that work. The per cents. given in this chart represents the per cents. of total production in the United States. This is more readily shown by Chart IV. and Chart V. At the same time that these graphic pictures are illustrating the relative importance of the various states as corn producers, they show the enormous change in the total production as far as the United States is concerned since the decade 1869-1878.

Corn per Capita.

As the corn crop is intended to serve mankind in one way or another, it is always natural to compare the yield with the population. Table II. gives the increase in population since the year 1850 and besides it the total production of corn in the United States since that time. It is noticeable that the corn per capita has gradually increased until it has reached the large amount of thirty-five bushels for each person in the United States. This means that corn alone adds twelve to fifteen dollars to the amount of money available for each individual.

More Corn to the Acre Desired.

But after all these facts are considered and we realize the importance of corn as a world crop, as a crop in the United States; as a crop in our own state, and as a crop in our own county, we turn to any teaching which will help us raise that crop more

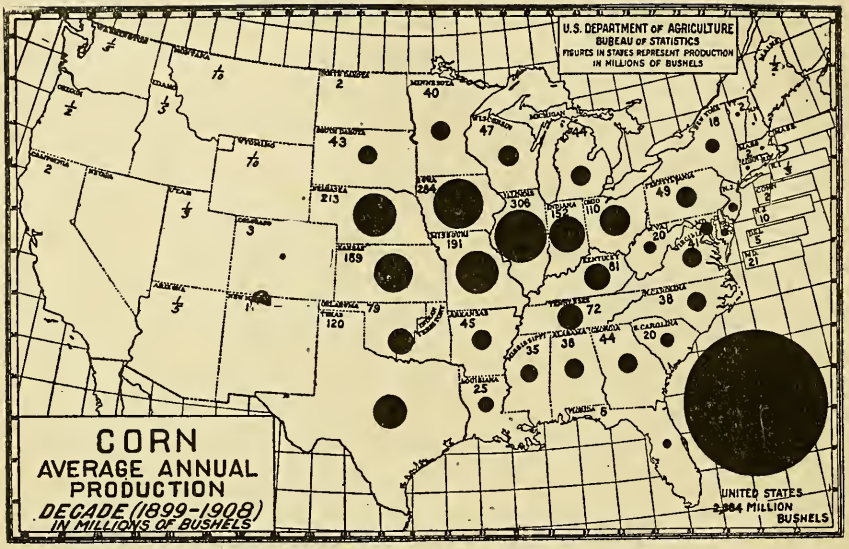


CHART IV.

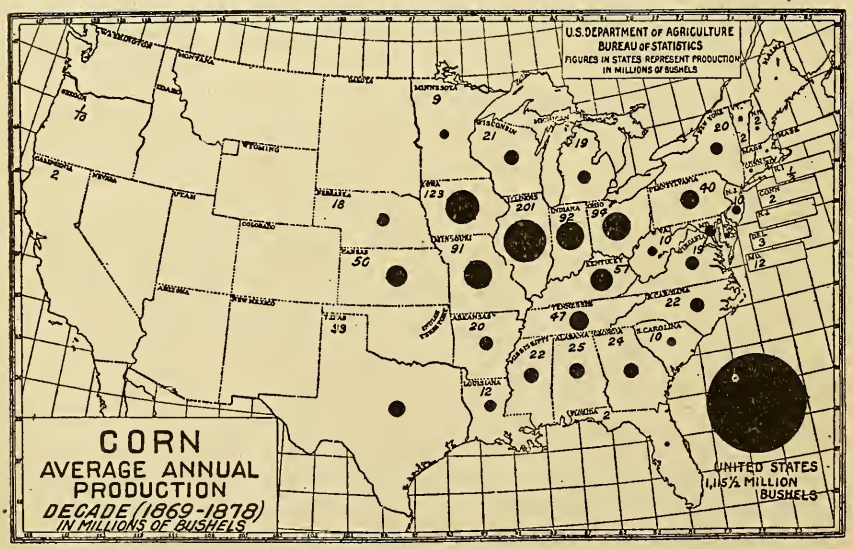
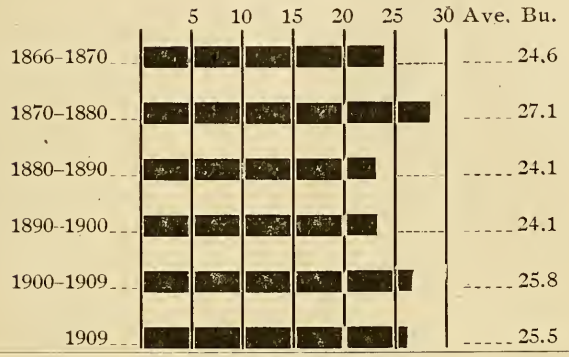


CHART V.

CHART VI

Yield Per Acre in the United States from 1866-1909



profitably. It is not uncommon nowadays to hear lectures on corn, and the main topic of discussion at these lectures is how to produce more and better corn to the acre. Figures and statistics will not enable us to do that work. They only act as incentives for greater effort on our part; and that effort is to be expended with the idea of raising more corn to the acre.

Yield per Acre in the United States.

It is interesting in this connection to note the yield per acre in average figures in the United States from 1866 to 1909. This is shown in Chart VI. It must be borne in mind that average figures are the only ones that can be justly used, and while instances may be known where 100 bushels, and over, of corn are raised on an acre of land, it is also known when we get the average figures that there must be some exceedingly low yields to bring the average so low.

Yield per Acre, Locally.

It is not a very bad comparison to use only the figures giving the average yield per acre; and, the student can do this not only in comparing his state with other states, but his county or township with other counties or townships. Table III. is given

with the idea of showing how this comparison can be made. The first column represents figures which are averages. The second column shows what the crop did in 1909. Getting a comparison of this kind, one is able to see whether his particular locality is achieving much along the lines of corn improvement.

To sum up all that has been said along these lines of statistics and figures, Table IV. will be used. This chart represents various phases of the question of which state leads in the production of corn. Data for 1909 are used and the states ranked according to acreage, but there are other figures in the columns which might perhaps have as well been used to bring out the points at hand.

TABLE III.

Average Yield per Acre, 1879-1908 and 1909.

Rank.	State or Territory.	Bushels 1879-1908.	Bushels 1909.	Rank.	State or Territory.	Bushels 1879-1908.	Bushels 1909.
1	New Hampshire	38.9	35.1	26	Nevada	25.2	....
2	Ohio	38.0	39.5	27	West Virginia	24.8	31.4
3	Iowa	37.9	31.5	28	Oklahoma	23.7	17.0
4	Vermont	37.9	37.0	29	South Dakota	23.3	31.7
5	Massachusetts	37.2	38.0	30	Arizona	23.3	32.0
6	Illinois	36.9	35.9	31	Oregon	22.7	30.7
7	Connecticut	35.9	41.0	32	Tennessee	22.6	22.0
8	Maine	35.3	38.0	33	Delaware	22.3	31.0
9	Indiana	34.4	40.0	34	Montana	22.1	35.0
10	Pennsylvania	33.7	32.0	35	Washington	20.7	27.8
11	New Jersey	33.4	32.7	36	New Mexico	20.3	31.3
12	Nebraska	33.1	24.8	37	Virginia	19.4	23.2
13	Wisconsin	32.9	33.0	38	North Dakota	19.4	31.0
14	Rhode Island	32.6	33.1	39	Texas	19.3	15.0
15	Missouri	31.9	26.4	40	Arkansas	18.9	18.0
16	Michigan	31.0	35.4	41	Utah	18.9	31.4
17	California	30.8	34.8	42	Wyoming	19.9	28.0
18	Dis. of Columbia	30.7	....	43	Colorado	17.8	24.2
19	Minnesota	30.0	34.8	44	Mississippi	15.7	14.5
20	New York	30.3	34.5	45	Louisiana	15.7	23.0
21	Kansas	29.1	19.9	46	Alabama	13.7	13.5
22	Maryland	28.4	31.4	47	North Carolina	13.1	16.8
23	Indian Territory	26.0	....	48	South Carolina	11.0	16.6
24	Idaho	25.3	30.6	49	Georgia	10.8	13.9
25	Kentucky	25.3	29.0	50	Florida	9.8	12.6

Note:—All states except Oklahoma, South Dakota, Wyoming, Nevada and District of Columbia are figured for the total 30-year basis.

TABLE IV.

Rank in Corn Production, 1909.

State.	Acreage.		Yield in Million Bu.	Value.	Per Cent. Tot U. S. Crop.	Average Bu. Per Acre.	Price per Bu.	Val. per Acre.	Quality.
Illinois	10,300,000	..	370	$192,280,000	13.3	35.9	$0.62	$18.67	...
Iowa	9,200,000	..	290	142,002,000	10.4	31.5	.58	15.44	...
Missouri	8,100,000	..	214	126,166,000	7.7	26.4	.66	15.58	...
Indiana	4,913,000	..	197	98,260,000	7.1	40.0	.64	20.00	...
Nebraska	7,825,000	..	194	97,030,000	6.9	24.8	.55	12.40	...
Kansas	7,750,000	..	154	83,292,000	5.5	19.9	.61	10.75	...
Ohio	3,875,000	..	153	85,715,000	5.5	39.5	.69	11.40	...
Texas	8,150,000	..	122	92,910,000	4.4	15.0	.75	11.40	...
Kentucky	3,568,000	..	103	64,153,000	3.7	29.0	.73	17.98	...
Oklahoma.	5,950,000	..	101	55,632,000	3.6	18.0	.62	9.35	...

It is interesting, in noting the columns of Table IV., to take into account the blank colums of "% of Farm Lands" and "Quality." The former figures were difficult to secure accurately, so the column was left blank. The suggestion, however, of that item in the comparison is present. The column of data regarding "Quality" would be well nigh impossible of expressing, but that there is a difference in quality, in corn from one state as compared with that of another, there can be no doubt. And so a careful inspection of the market reports, giving grades on corn from different places, might well be made.

LABORATORY EXERCISE.

Take the last Year Book of the U. S. Department of Agriculture that you can secure and find from the figures given in it whether your own state and community has improved to any material extent in the work it has been doing along corn grow-

ing. A letter to your Congressman will secure this book for you, free of charge. A letter to your Governor will determine for you whether your own state produces a State Year Book. If it does, secure one of these books and a closer account of the corn-producing sections of your district can be found.

THE HISTORY OF CORN.

Doubt as to Its Origin.

As was said in the introduction of the work, corn has made for itself a history; one which perhaps no other cereal has made, and yet we are not exactly sure of its origin. Some have said that corn originated in China. Some have said that it originated in Mexico, South America, and some would even have the crop produced first in some of the islands of the Atlantic Ocean. But it is pretty definitely established that America holds first claim to the crop which she now holds first claim to produce.

DeCandolle's Account.

DeCandolle, who wrote some time ago, gave a history of corn which is pretty generally accepted, at least it can be said of him that his book on the "Origin of Cultivated Plants" is more frequently quoted than any other book along the same line. He says of corn that it "is of American origin and has only been introduced into the old world since the discovery of the new. I consider these two assertions as positive in spite of the contrary opinion of some authors and the doubts of the celebrated agriculturist Banofous, to whom we are indebted for the most complete treatise on maize. No one denies that maize was unknown in Europe at the time of the Roman Empire, but it has been said that it was brought from the East in the Middle Ages. The principal argument is based upon a charter of the Thirteenth century, published by Molinari, according to which two crusaders, companions in arms of Boniface III., Marquis of Monferrat, gave in 1204 to the town of Incisa a piece of the true cross and a purse containing a kind of seed of a golden color and partly white, unknown in the country and brought from Australia, where it was called meliga, etc. The historian of the Crusades, Michaux, and later Daru and Sismondi, said a great deal about this charter, but the botanist Delile, as

well as Targionitozzetti and Bonafous himself, thought that the seed in question might belong to some sorghum and not to maize. These old discussions have been rendered absurd by the Comte de Riant's discovery that the charter of Incisa is the fabrication of a modern impostor. I quote this instance to show how scholars who are not naturalists may make mistakes in the interpretation of the names of plants; and also how dangerous it is to rely upon an isolated proof in historical questions."

This characteristic argument follows through the work of DeCandolle until the reader comes to believe that Indian corn or maize, notwithstanding the fact that it was grown early in Egypt and India and China, came from America. He says as a conclusion to his argument that "maize is not a native of the old world. It became rapidly diffused in it after the discovery of America, and this very rapidly completes the proof that had it existed anywhere in Asia or Africa, it would have played an important part in agriculture for thousands of years. We shall see that the facts are quite contrary to these in America. At the time of the discovery of the new continent, maize was one of the staples of its agriculture, from the La Plata valley to the United States. It had names in all the languages. The natives planted it around their temporary dwellings where they did not form a fixed population. The burial mounds of the natives of North America who preceded those of our day, the tombs of the Incas, the catacombs of Peru, contain ears of grains of maize, just as the monuments of ancient Egypt contain grains of barley and wheat and millet seed. In Mexico, a goddess who bore a name derived from that of maize answered to the Ceres of the Greeks, for the first fruits of the maize harvest were offered to her, as the first fruits of our cereals to the Greek goddess. At Cusco the virgins of the sun offered sacrifices of bread made from Indian corn. Nothing is better calculated to show the antiquity and generality of the cultivation of a plant than this intimate connection with the religious rites of the ancient inhabitants. We must not, however, attribute to these indications the same importance in America as in the old world. The civilization of the Peruvians under the Incas and that of the Toltecs and Aztecs in Mexico has not the extraordinary antiquity of the civilizations of China, Chaldea, and Egypt. It dates at earliest from the be-

ginning of the Christian era; but the cultivation of maize is more ancient than the monuments, to judge from the numerous varieties of the species found in them, and their dispersal into remote regions."

Corn an Old Crop to America.

And so it can be readily seen that corn is a very ancient crop. In America, the Indians, of course, raised much of it before the white man came, and after the white man settled in this country and began to conquer one place after another, he, of course, learned much from the Indians as to how to select the best ears for seed, and how and when to plant the corn. Of course, their ideas were very crude. The Indians usually cleared a small spot and the squaws did the planting by making small holes in the ground with a stick and dropping in each hole the number of kernels they desired. Sometimes a small fish would be used as a fertilizer. In the fall the corn would be picked and stored away in pits dug in the ground. Such methods as these we have reason to believe were used by the early settlers of this country, but the native ability of the white man led him to improve the methods in vogue among the Indians, and it soon became possible for him to cultivate a large area in producing the corn that he desired.

Work of the Colonists.

The first successful attempt of the English to cultivate corn in North America was in 1608, and that along the James River in Virginia. Before that time, there must have been some fairly good corn raised, for, soon after it, as many as thirty acres in one piece are recorded. It is said that as early as 1650 corn to the extent of 600 bushels was exported from Savannah, and by 1770 the amount exported from this same place had reached 13,598 bushels. From this time on, the average increased very rapidly until we have the enormous figures already recorded. The main increase in yield in the United States has been due to the increased acreage. Now that the corn acreage is practically complete, it is necessary to increase the yield per acre.

THE ORIGIN OF CORN.

Directly in connection with the history of corn should come the origin of the corn plant. For long before the history of corn began, the history of the corn plant was in the making. All plants are known to have come from lower forms and it has been the effort of many writers to ascertain what was the form of the plant from which the present corn plant came. It might be well to note a few things which can be seen when the green corn plant is developing. We have developed at the top of the plant what is commonly called the tassel. Below this tassel, some distance down on the stalk, we have the ear of corn, borne on a shank much the same as any fruit would be borne on a stem. The leaves of the corn stalk alternate from one side to the other the entire length of the plant. If we would imagine the plant as branching at every place where the leaves originate, we would have what is now thought to be the parent of the present corn plant. In other words, the corn plant came from a very much divided and branched plant. As the ear developed, the lower branches, which were practically useless, were discarded, became dwarfed, and of no use whatever to the plant. Only the one branch, namely, that on which the larger ear was developing, was permitted to continue growth. This ear, or surrounding it, were branches which had been doing the same work that the tassel does. The tassel had been occasionally developing kernels of corn, but as the years passed, the tassel developed into the form we now have it, which furnishes pollen and does nothing else. The ear developed only kernels and left the tassel for its work of pollenation. As a result, there is established the so-called male (tassel) and female (ear) parts of the plant. The closest plant, which we have today, to which we might credit the origin of corn is the Teosinte plant. It is a much branched plant bearing the seed at the ends of all the branches.

Since the ear originally was a tassel, the question naturally arises, how is it that there is always an even number of rows on the ear of corn, and the question may be answered by saying that the central part of the tassel which developed into the ear bears an even number of rows of flowers. The side branches of the tassel of course have diminished until we see them now only in freak specimens of corn.

Laboratory Exercise.

Secure from the field any ears which seem to be misformed. If they have a part of the tassel hanging to them, notice the way that the central part of the tassel seems to have developed in proportion to the other parts. Many freak ears are due to the fact that the corn plant producing such ears is going back to the original type from which it first came.

THE BOTANY OF THE CORN PLANT.

The Kernel.

In reality, when anyone studies corn, or any crop which is cultivated by man, they are studying botany in one phase or another. The whole purpose of all plants is to produce seed which will have the power to reproduce the plant. In other words, the final work of any plant is the production of seed. Especially is this true of cereals. And so the study of the kernel itself, when corn is being considered, is of a very great deal of importance. Plate 2 represents the parts of the corn kernel. Take the external features of the kernel alone, we have what we might term two parts: the germ, in which lies all the living matter, by means of which the plant of the coming year is able to start; and the endosperm, in which the food material is stored. The diagram of Plate 2 gives these parts more in detail.

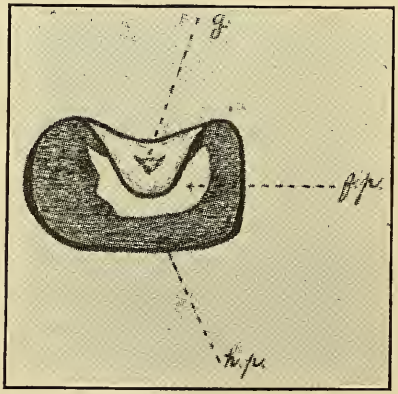


PLATE 3—CROSS SECTION OF KERNEL
g, germ; *fp*, floury or starchy portion; *hp*, horny or corneous portion

The Plant.

Although the average person does not think of corn as belonging to the same type of plants as oats and timothy, yet that is true. In the botanical world there are a great many families of plants. One of the largest of these families is the "grass" family, known as "gramineae." Into this family, corn, oats, wheat, barley, rye, blue grass, timothy, and many other of our common farm crops fall. These plants are characterized by their hollow stems, their fibrous root systems, their leaves with parallel veins, and their seeds being borne in small leaf-like structures.

Parts of Corn Plant and Their Uses.

Root Starts.—Each one of the parts has a definite use. Before giving those uses, it will be necessary to go into detail as to the general structure of the plant itself. As soon as moisture surrounds the kernel, the embryo, or germ, within the kernel, begins to swell and the root branch, or the radicle, breaks through the seed coat and begins its way into the soil. This radicle at its

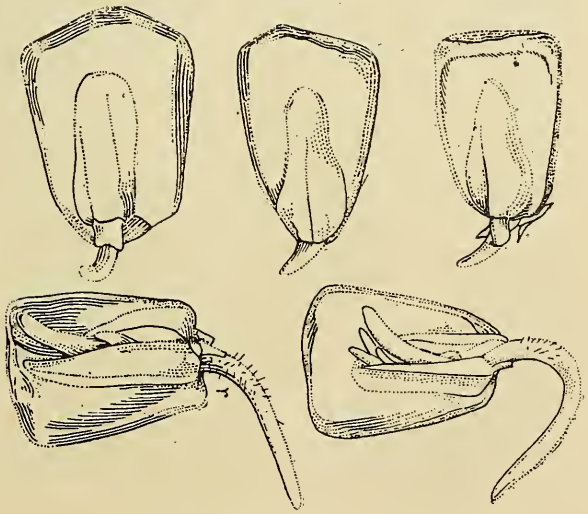


PLATE 4—KERNELS GERMINATING

Primary root indicated by *r*. In lower right-hand drawing, some adventitious roots are showing.—*Pammel, Grasses of Iowa.*

tip is covered by a cap as are all the other roots which develop later. This part of the root system, that is the cap, is known as the "root cap" and acts as a protection as the root works its way between the soil particles.

Beginning of Leaves.—Soon after the radicle develops into the root which we know as the primary root, the plumule or the miniature leaf in the embryo breaks through the upper part of the embryo and begins the formation of the plant above ground. This plant unfolds much in the same way that a telescope will unfold; and it grows rapidly to its full height.

The Root System.

In the meantime, the roots are also developing. Just above where the primary root is attached to the embryo of the seed, adventitious roots start. These adventitious roots grow rapidly and begin to take plant food from the soil. They ramify in all directions, attempting to accomplish this purpose with the greatest ease. Of course, before the time that they are able to take plant food readily from the soil, the young plantlet must draw for its supply of growing material upon the endosperm of the seed itself. As soon as the food material of this endosperm is exhausted, and all of it is necessary in producing the young plantlet, there is noticed in the soil nothing but the seed coat of the original kernel. Right at that point it is noticed that the adventitious roots are strongly developed and also that the primary root has died. That is, the root which came out directly at the radicle point was of no service after the development of adventitious roots. This is true of the grasses.

Each part of the rootlet will be seen to be covered with fine hairs which are called root hairs. As the roots are pulled from the ground these root hairs obscure themselevs by holding a large quantity of soil to the rootlet. Their action in the soil, as the plant is growing and developing into organs of usefulness, is to take in plant food which has been dissolved in the soil for its use. In the meantime all of the rootlets are growing still farther into the soil, guarded as they are by the root caps at their extremities. As soon as the plant food is absorbed by these root hairs it is taken into the central part of the rootlet, which is known

as the central cylinder, and carried from there to the part of the plant where it is needed. The plant itself, partly by the action of the roots and partly by its own action above ground, has been able to grow to large proportions and the wind, as it pushes the plant to and fro, has demanded some sort of protection against the breaking of the stalk. This protection is seen in the form of what are called brace roots. Brace roots are nothing more than the ordinary roots of the plant. The plant is made up from top to bottom of what are known as nodes and internodes, the nodes being those parts which one might readily call joints on the plants, and the internodes being the parts between those different joints. These brace roots that come out of the plant will be found

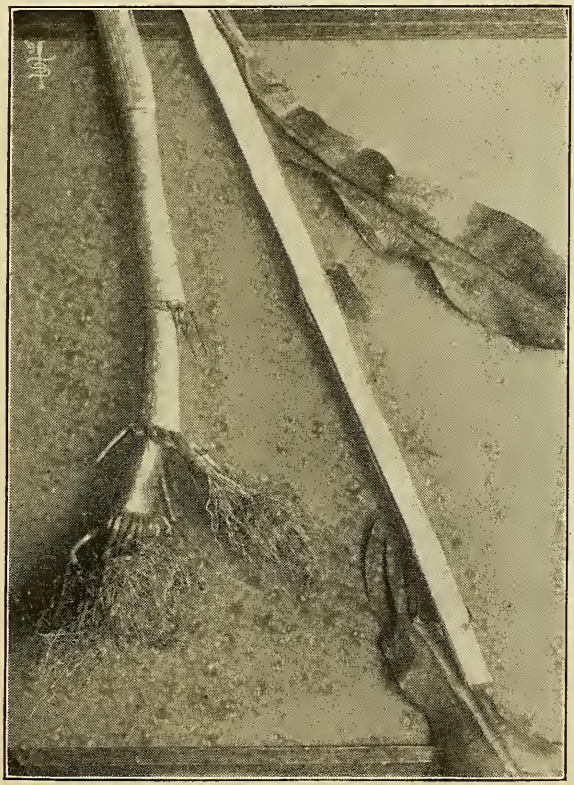


PLATE 5--CORN ROOTS AND STALK

Brace roots are seen. Some have entered and have become feeding roots. The split stalk at the right shows the nodes as merely partitions of the stalk. --*Iowa State College.*

to develop at the nodes. The roots below the ground have also developed at the nodes. If these brace roots enter the ground as they sometimes do and begin to send out their small branches to all parts of the soil they will have the same use as the underground roots; that is, the taking of plant food for the purpose of adding to the growing plant. But the brace roots also have the special function of supporting the plant and it is pretty generally thought that whether the brace roots touch the ground or not, their presence and the fact that the plant shows a tendency to develop brace roots indicates a strong system of roots under ground, and this, of course, would mean a more favorable condition for any plant.

As this plant, at the stage when the brace roots are developed, has become quite large, the prominent features of all of the plant are noted. First of all, the stem is hollow, as is true with other grasses. That is, there is a material much harder than any of the rest of the plant on the outside of the stalk, so that if a cross section of the stalk is made a circle of hard, woody material is seen. The purpose of this hollow column is well shown in practically all buildings of any size whatsoever. The columns which are put into those buildings are hollow. Being hollow, they offer a greater support for the material used than would otherwise be true. So it is with the corn plant and with the oat plant. The hollow stem gives a greater support, which is needed when the ripened ear bears down with all its force upon the plant below.

Within the hollow column is noted, in the case of the corn plant, a great deal of bulky material which we term the pith. This pith has two functions, primarily. The first, perhaps, is to support the plant from injury as it is blown by the winds. The principle is shown if we have a rubber tube well filled with water and one that is not. Perhaps both of the tubes will stand upright when there is no pressure from the outside, but, if a side pressure is given to both tubes, the one which has the least amount of water will bend first. As another example, if a piece of paper is made into a cylinder, unless there is some support from within pushing outward on the sides of the tube, these sides will collapse if any great pressure is brought to bear. Corn, since it is a tall plant, must resist a great deal of the action of the wind, and

so possesses this pith which constantly pushes outward on its walls. The pith also has the function of holding food material and plant water until such time as it will be needed by the plant.

The nodes, which we have said might commonly be called joints, but which are no more joints than the partition between two rooms is a joint between the two rooms, also aid the pith in assisting the cylinder of woody material in maintaining its rigid

PLATE 6—SECTION OF A CORN STALK

The node and the pith holding numerous fibro-vascular bundles above it are shown.—*Iowa State College.*

form. Through the pith and up through the woody wall of the stalk we have extending what may be called tubes, but better called "fibro-vascular bundles." These bundles give a great deal of support to the plant but, at the same time, they are carrying plant food from the roots to the green parts of the plant or to some other part where it is needed.

Outside of the structure of the stalk itself, which has been mentioned, is the epidermis which corresponds to that similar covering which is developed in all forms of higher plants. This epidermis acts mainly as a protective covering guarding the parts

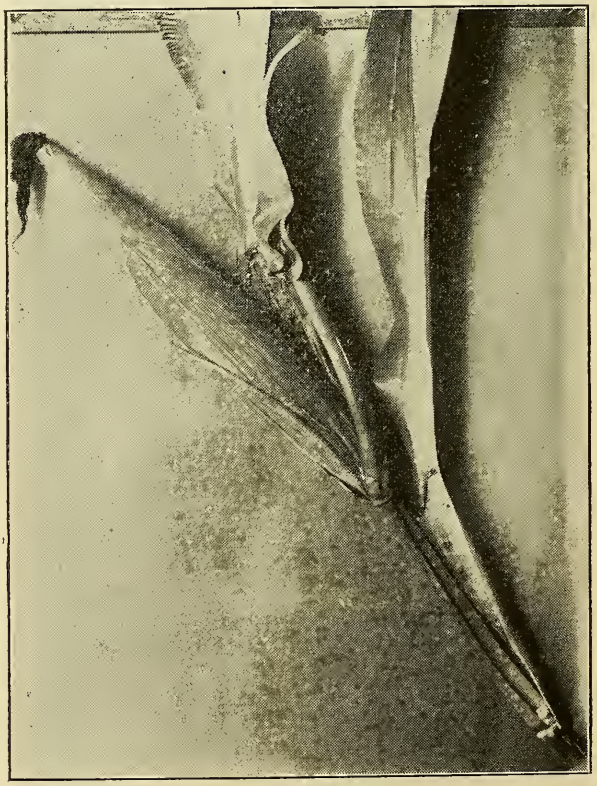


PLATE 7--EAR AND LEAVES

Lower leaf shows where, in the groove of the stalk and under the leaf sheath, the lower ear was attached. The rain guard on each leaf can be seen. The leaf sheath of lower leaf extends almost to node above.—*Iowa State College.*

of the stalk which are tender and need a great deal of care if they are to perform their functions to the best advantage.

The leaves of the corn plant are arranged, as has been said, alternately from the top to the bottom of the plant; that is, a leaf is found first on one side, then up at the next node on the other side is the next leaf, and so on up the plant. Each node of the plant bears a leaf. From the node where the leaf is attached, up the stalk for eight inches, more or less, extends what we call the leaf sheath, wrapped tightly about the stalk itself. This leaf sheath acts in conjunction with the woody wall to make a hollow cylinder of hard material for support. Underneath the leaf sheath may be found the bud which corresponds to the branch which originally came from the plant; that is, from the plant as it existed hundreds of years ago. The leaf sheath turns off into the leaf blade itself. At the point where the leaf separates from the stalk proper, and bends into the air in graceful form, is an extension which wraps itself tightly around the stalk and known as the rain-guard. This rain-guard is a fringed piece of material which, as its name suggests, has the function primarily of keeping moisture from going down between the leaf sheath and the stalk itself. As a matter of fact, in corn this use is not prominent, but in small grains, where it is necessary for the leaves to swing by their leaf sheath to a certain extent, it is necessary that there be no dirt between the leaf sheath and the stalk. In corn, however, the leaves do not depend upon this axle motion for their protection against the winds. The principal protection which the corn leaf shows is that of the uneven edges of the leaf. The corn leaf as it begins to grow does so more rapidly at the edge of the leaf than it does at the central part. As a result there is the wavy appearance which is so common to every one familiar with corn. As the wind blows the leaf from side to side the wavy edges permit the leaf on one side to be stretched and the other side to be folded. This means that there is no tearing of the leaves and that the plant is not unnecessarily strained. The central part of the leaf has a collection of the fibro-vascular bundles, and by means of them is able to maintain a graceful support of the leaf itself.

As one goes further up the plant it is noticed that the ear comes from under a leaf sheath. In fact, in ascertaining whether a stalk is a barren stalk or not the leaf sheath is usually felt. This

of course is in accordance with the development of the plant, which has already been mentioned. The ear is borne on a shank composed of nodes and internodes just as the stalk itself is composed. Leaves arise at each node, but with the ear we call those leaves the husks. In fact, it is supposed that, as the present plant was developing from the original plant already cited, the branch merely contracted in size, all the leaves remaining; and in doing so, they covered completely the ear of corn. So we have surrounding the ear and its kernels a protective covering of leaves differing in their structure from the ordinary leaf because of the functions they have been forced to perform.

Terminating the stalk is the tassel. From this tassel comes the pollen grains which make it possible for kernels of corn to develop. Each one of these tassels is composed of numerous flowers which bear only the male organs. These male organs are composed of a slender support on which rest hollow sacks. In this hollow section is manufactured the pollen so essential in the production of corn. It is interesting to note at this place that these hollow sacks, or anthers, open at the side, after they have drooped

PLATE 8—A SINGLE FLOWER

over, in order that the plant may avoid self-fertilization. For corn requires cross-fertilization for perfect results. These sacks also, if they were end opening, would lose their pollen much before such would be desired. Being side opening, they permit the wind to distribute the pollen at its will. These pollen sacks on their slender supports extend out of small leaf-like pockets, just as is true of many grasses; but on the tassel we have very seldom developed any organs which may be classed as female organs. That is, the whole function of the tassel is the production of pollen for the fertilization of flowers borne elsewhere. Those flowers appear on plants throughout the field at the place where later we find the

PLATE 9—EAR AND TASSEL IN BLOOM

Each kernel is represented by a silk. Each pollen sack contains many pollen grains.—*Iowa State College.*

ear of corn itself. The young ear of corn before any pollen has reached it is nothing but the cob, as we ordinarily know it, covered with a great many flowers which do not have any male parts. The tassel in most cases develops before the silks of the ear. The silks of the ear as they develop correspond to, and are, in fact, the pistils of the plant. Each would-be kernel sends forth a silk which pushes itself from out the husk and is ready for pollenation by the pollen from some other stalk.

The ear really develops in three sections. That is, the kernels form the lower part of the ear send out silks first; the kernels from the central part of the ear send out silks next; and the tip last. Each silk that comes out requires one pollen grain in order that the kernel from which it came may be able to develop, but there is little difficulty in securing pollen enough to accomplish this work. It has been estimated that each anther, or pollen sack, produces about 2,700 pollen grains. A single tassel contains 7,500 pollen sacks, making a total of 30,250,000 pollen grains per plant in the cornfield. It is estimated from this that if every grain of pollen were to reach a silk there would be 30,250 grains for each ovary if each stalk produced but one ear as is ordinarily the case. As soon as the pollen grain reaches the silk, the egg on the cob is fertilized and the kernel begins its development. From them we have developed all the parts which are noticed in the natural kernel. The plant food has been taken from the soil, and also from the air and turned into forms which can be used or stored in the kernel.

At this point it is interesting to notice just how it is that the plant gets this food material which is so necessary for the development of itself and the reproduction of its kind. Nothing has been said so far concerning the fact that the plant is green in color. It has been mentioned that the root hairs and the rootlets are able to absorb from the soil certain plant foods which are necessary for the growth of the plant, but at the same time that this action is going on, the leaves are appropriating the water which the roots are sending to them and are taking in through pores in their epidermis carbon dioxide gas from the air. This water and carbon dioxide gas are united in the leaves to form starch. This is done by means of the green coloring matter in the leaves and the action of sunlight upon that green matter. The coloring matter

itself is called chlorophyl. The process is called photosynthesis. This plant food then, which has been secured from the soil and from the air, is used by the plant in the development of the kernels. It is, of course, carried to the kernels in liquid form. All food materials are transported in that way in all plants.

The embryo is first formed and then the remainder of the kernel. In this process we have brought to the kernel a great deal of food material. As the plant matures and the grains get harder, this food material is placed in definite parts of the grain itself and we have arranged those parts as has already been indicated in Plate 11.

With the completion of this work we have the completion of the growth of the corn plant and it dries at the same time that the ear is maturing.

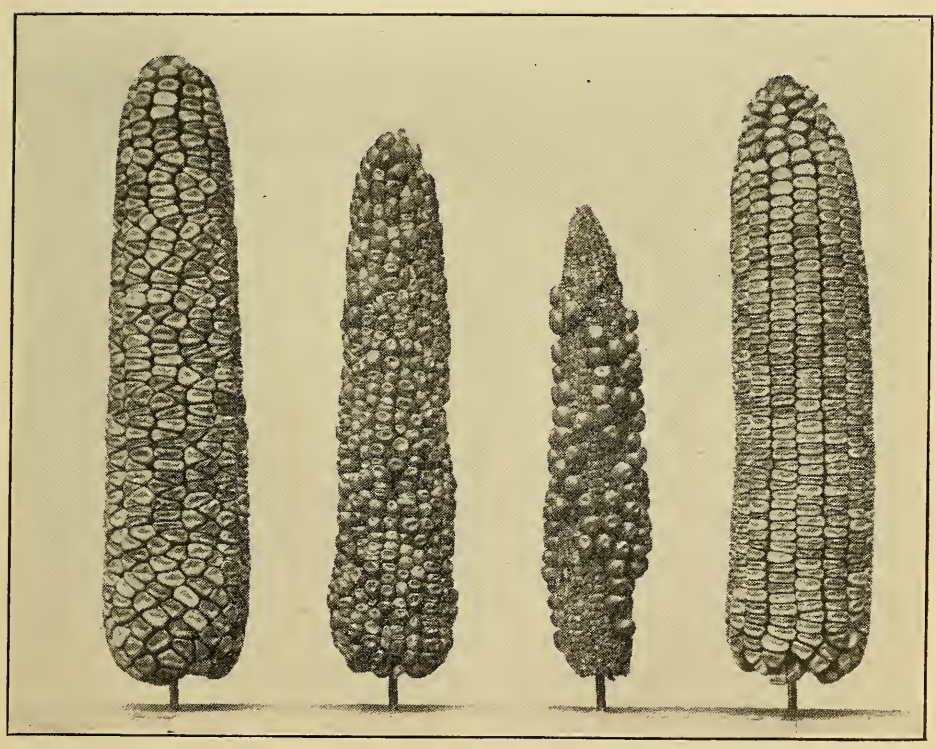


PLATE 10—FAULTY POLLINATION

For some reason many would be kernels were never pollenated and irregularly formed kernels are the result.—*Iowa State College.*

LABORATORY EXERCISE.

Part I.

Secure some well formed kernels of corn and moisten them well in warm water. After the seed has swelled quite a little, remove it from the water and by the use of a penknife separate the various parts of the kernel. The three parts which will be most easily separated will be the hull, the endosperm, and the embryo. At the same time that this is being done the other parts given in Plate 11 may be noted.

Part II.

Take a number of well formed kernels, put them between moist cloths which are to be kept moist, or put them in an ordinary seed corn germination box, and allow them to germinate. Note daily the following results: Radicle breaking through the seed coat; beginning of the plumule formation into leaves; adventitious roots starting underneath the seed coat just above the radicle; root hairs on all roots; green coloring matter beginning to show in the leaves.

Note.—It will be necessary to have the corn germinate in the light if the green coloring matter shows.

Part III.

Secure a well developed stalk and look for the following items: nodes, rain-guards, leaf blade, woody wall of the stalk, pith, fibro-vascular bundles. At the same time that these points are being noted recall their use as it has already been stated.

CLASSIFICATION OF CORN.

Nothwithstanding the fact that the plant is of so much importance in the production of good corn, all writers so far have taken into consideration mainly the ear and the kernel in classifying corn into various types and varieties. This is because the

ear is available at all times, while the plant is not. And so whatever is mentioned by any one in regard to the classification of corn will be based upon the ear itself.

Corn as a separate species is termed *Zea mays*. Dr. E. L. Sturtevant, in his bulletins on "Varieties of Corn," published by the Office of the Experiment Stations, in 1899, says: "The species Zea mays includes exceedingly divergent forms. The height of the plant in varieties and localities has been reported from eighteen inches for the Golden Tom Thumb pop to thirty feet or more for varieties in the West Indies, and single stalks in Tennessee at 22¼ feet. I have seen ears one inch long in the pop class and sixteen inches long in the dent class. The rows in varieties may vary from eight to twenty-four or more, and in individual ears are reported from four to forty-eight. A hundred kernels of Miniature pop weighed 46 grains; of Cuzco Soft, 1,531 grains. In some varieties the ears are long and slender; in others, short and thick; in the Bearfoot pop, flat. Some varieties have flat kernels; other varieties have spheroidal kernals; yet others, conical kernels. The summits of the kernels may be flat, rounded or pointed, or indented."

So Dr. Sturtevant continues to mention differences in the ear and differences in the kernel, in structure and in form, and also in prolificacy, or the ability of the corn to produce a great deal of other corn. In noting these differences and in attempting to classify all corn that we know at the present time into types, Dr. Sturtevant outlines the following types of corn and gives their characteristics. These types are made primarily on the arrangement and character of the endosperm, although resulting therefrom are noted marked variations in the shape of the grain. If a Dent Mays is split through its two longest diameters, the endosperm will appear to consist of two parts. (See Plate 2.) One will be white and starchy, the other will be glossy or horny. On characters such as these, Dr. Sturtevant makes his separation.

Types of Corn.

1. Pod Corns (Zea tunicata).
2. Pop Corns (Zea everta).
3. Flint Corns (Zea indurata).

4. Dent Corns (Zea indentata).
5. Soft Corns (Zea amylacea).
6. Sweet Corns (Zea saccharata).
7. Starchy-sweet Corns (Zea amyleasaccharata).

There are given three types of kernels under each of the above types: (A) The kernel broader than deep, (B) the kernel as deep as broad, (C) kernel deeper than broad. The characters given for each type seem independent of climate or cultural conditions.

1. **Pod Corns.** In this group each kernel is enclosed in a pod or husks, and the ear thus formed is enclosed in husks. Besides being called Pod Corn it is often named Egyptian Corn, Primitive Corn, Husk Corn, and Forage Corn. The plant itself is very leafy and suckers abundantly, in this way suggesting the primitive type from which it must have come. Occasionally now there is seen in cultivated fields of corn a reversion to this old and primitive form.

"The pod corn specimens that we have studied are very resistant to weevil infection. Once our whole collection of varieties of corn was destroyed except the pod corn. The kernels of all the groups that we have found on podded ears are of a very flinty character, and are in the podded specimens slightly smaller than in their unpodded forms. Humboldt says of maize in America, that 'when left to nature the birds prevent their reproduction by destroying the seeds.' Podded corn is less conspicuous than the naked kernels of cultivated varieties, and is looser on the cob, yet firmly attached. This favors protection from and distribution by birds. As insect and bird depredation furnish the strongest barrier to the growing of wild forms of maize, these protective characters assume an importance in the argument in favor of pod corn being an aboriginal form, and justify Darwin's conclusion previously quoted. The property of floating upon water, which the podded kernels possess in strong degree, would also facilitate distribution in a state of nature, as also the moisture retained within the pod."

2. **Pop Corns.** These corns are characterized by the excessive proportion of the corneous or horny endosperm and the small size of the kernels and ear. This horny texture gives the ability of these corns to pop. Popping is the complete turning inside out

of the kernel through the explosion of the contained moisture on the application of heat. A little starch present in the kernel will not prevent proper popping, but very much or an excess allows the kernel merely to split when heat is applied. The true pop corn is tender in its eating. There is only one type of corn with which one would confuse the pop corn, and that is the flint. Flint corn, however, has a larger kernel and has not the ability to pop.

Of the varieties of pop corn there are really two classes: (1) the rice and (2) the pearl. The former is pointed and sharp on the outside, the latter is smooth and round. Both are good pop corns.

The plants vary in size from a few inches to several feet. The ears are of various lengths. The pop corns seem to be more subject to freak growths than any other type, and are capable, as a rule, of producing more ears to the stalk than any other type.

3. **The Flint Corns.** These corns are characterized by the flinty endosperm surrounding a starchy portion of much bulk. The hard, flinty portion varies in thickness, but is always so thick that when the kernel dries there is no dent. The width of the kernel is usually greater than the length. The ear is long and small in circumference; the plant is small, suckers freely and is able to mature good corn in from 90 to 140 days, the more frequent period being about 100 days. This makes it an excellent variety for some of the northern states, like the Dakotas, Minnesota and Wisconsin, New York and the New England states, where it is grown with a great deal of profit and in abundance.

4. **The Dent Corns.** This is the type of corn which is grown so commonly. It is recognized by the corneous endosperm, or the flinty portion, at the sides of the kernel. The flinty portion is lacking at the tops of the kernels and as a result there always occurs the dent from which the type is named. When such corn is taken north from the section in which it is native, more of that horny matter which characterizes the flint corn is developed, and as a result the dent decreases; and only with a great deal of careful selection will it remain a well bred dent corn. The plant is characterized by a strong and vigorous growth, broad leaves, few suckers, and usually only one ear to the stalk. The kernels in their physical characteristics are wedge-shaped, usually longer

than they are wide. In fact, the type as a type is noted for the depth of the kernels, and the large germs. The time required for maturity will vary from 110 to 150 days, but a period of 130 days is usually considered the extreme limit.

It is on this corn that the trades of the continents with regard to corn are established. If all the corns were noted as they affect commerce and local trade, there would be but two to be considered: Flint and Dent. And of these two the dent type by an overwhelming majority would have first place.

At this place it might be well to insert the qualities that go to make a good dent ear of corn, such an ear as is shown on the first pages of this paper. A good dent ear of corn will be in general shape cylindrical or nearly so, with well shaped kernels running uniformly from the butt to the tip in straight rows. The kernels will be wedge shaped, not peg shaped; and their length will be from one and one-half to two times the width. The germs will be large. The tips and the butts of the ears will be well covered, that is, regularly covered with straight rows of deep kernels. The shank will be just large enough to accomplish its purpose, which is to support the ear on the stalk until husking time. The size of ear will be no larger than will mature in the district where the ear is being grown. Its proportion will be approximately as follows: the circumference three-quarters of the length.

5. **The Soft Corns.** This type of corn has no flinty endosperm whatsoever. As a result of uniformity of drying there is no dent in the kernel. A great many of the mummy corns that have been discovered in various parts of South America would come under this class. However, that such corns are found only in southern countries is not true, for some specimens have been secured from Manitoba.

6. **Sweet Corns.** This is a well defined group of corns which are very well known in most parts of the United States. They are characterized by the translucent, horny appearance of the kernels and their more or less crinkled, wrinkled, or shriveled condition. This type seems to be less subject to freak growths than many of the others. "It is extensively grown for canning purposes, and is grown in Maine as a field crop for this purpose in

localities too far north for the ripening of seed. A number of the early varieties ripen their crop as far north as Ottawa, Canada. On account of the property of the seed ripening on the cob when picked at an early stage of edible maturity it is difficult to say how far northward it might not be grown in the care of intelligent growers. Sweet corn seems to be but little grown in our Southern states, and apparently improves in quality as it moves northward. The principal packing districts in 1891 were in Maine, New York, and the Atlantic coast as far south as Virginia, although the business is assuming importance in the central west."

7. **The Starchy Sweet Corns.** The appearance of the kernel of this type is that of the sweet corn, but the structure shows only the top to be like the sweet type. The lower half of the kernel is like to soft corns. There is little known about these corns and they have not been produced to any commercial extent.

Laboratory Exercise.

Write to some reliable seed house and ask them if they could secure an ear of each of the various types of corn for you. After you have been able to get the corns, place the ears side by side and note the following points: size of ear; shape of ear; kernel coating; shape of kernel. Cut the kernel through in two directions and note the composition, looking for the starchy part, the horny portion, and the germ.

COMMON VARIETIES OF DENT CORN.

In each type there are varieties, but the varieties that are of interest to most of the farmers of the country are those of the dent type. Varieties are distinguished by difference of the ear. Very little attention is being paid to the stalk, although experimentalists are emphasizing that phase of the question more today than they have for several years. Sturtevant classifies about 325 varieties of dent corn, and to go into detail as to a very great many of them would be a tiresome task for any one, but the principle upon which they are classified becomes very interesting. Some of the points which are noted in making a distinction between one variety and another are:

1. **Shape of the Ear.** This may vary from the extreme taper to the extreme cylindrical, the one which tapers just slightly being the one which is considered the best.

2. **Length of Ear.** This will vary for the varieties, much depending upon the locality in which the corn is grown.

3. **Circumference of Ear.** Usually is about three-quarters of the length, but this will vary a little one way or the other with the variety.

4. **Condition of the Kernels.** Some varieties have kernels on the cob a little looser than other varieties.

5. **Color of Kernels.** The common varieties are different shades of yellow and white.

6. **Indentation of Kernels.** Some varieties have been bred for a deeper dent than others. As the corn is moved to the north the dent is reduced.

7. **Shape of Kernels.** Some kernels are wedge shaped, others are square shouldered. Each variety kernel has some pretty clearly defined characters.

8. **Length of Kernels.** Usually given as deep, medium or shallow.

9. **Number of Rows.** This will vary from eight to twenty-six.

10. **Space Between Rows.** It is not desirable to have much space between the rows, but some varieties are allowed more than others. The shape and the depth of the kernel will determine this to a great extent.

11. **Arrangement of the Rows.** Most varieties are paired, but a few varieties have each row distinct in itself.

12. **Filling of Butts.** Some varieties permit a flatter butt than will other variety types. Reid's Yellow Dent is well rounded. Boone County White is flat.

13. **Filling of Tips.** The tips should be well filled but not at the expense of some other part.

14. **Shank.** The cup shaped cavity where the shank was attached should be as small as the size of the ear will allow.

15. Size of Cob. The shelling percentage of a variety will depend upon this factor to a great extent.

16. Color of Cob. Most yellow varieties have red cobs. Most white varieties have white cobs. The red cobs vary in shade of red.

17. Per Cent. of Shelled Corn. The per cent. of shelled corn means the per cent. of the ear that is actual corn. Some variety standards are often given as high as 88 per cent., but this figure is really higher than the average good ears will really shell.

When one variety is being compared with another variety it is well to hold in mind the fact that unless the corn is normal, well matured and well dried the comparison will not be just. For example, an immature ear would probably show a much different dent than one that was not so immature. So, to make the comparison fair, it is necessary to secure well treated ears and then to have a great many of such ears of each variety, for if only a few ears are examined the differences noted may be those affecting only the ears at hand and not the variety as a whole.

A FEW STANDARD VARIETIES.

Reid's Yellow Dent. This variety has been grown in almost every state in the Union. In 1846 Mr. Robert Reid moved from Brown County, Ohio, to Tazewell County, Illinois. He took with him the corn then known as the Gordon Hopkins corn. He planted this corn on his farm near Delavan, Ills., but it did not prove the success he had hoped for (as it was too long in maturing). Because of a poor stand from his seed, the next season he replanted the field with the Little Yellow corn. As a result his seed for the following season was mixed, but from that time on he selected carefully, and others have done likewise with the same strain of corn. As a result we have a recognized variety in this corn wherever it is grown. Among the contemporary breeders is Mr. D. L. Pascal, of DeWitt, Iowa, who raised the ear shown in Fig. 1 of this paper.

Leaming is one of the old varieties, but the type of the ear has been changed to such an extent that at the present time there are few men who grow the real Leaming. It was developed by

J. S. Leaming while he was living at Wilmington, Ohio. Mr. Leaming took a great deal of care in the selection of his seed and after him his son carried on the work. Many of the varieties that are common today trace back to the Leaming blood, but few hold to that taper which characterized the first strains. Leaming is a good yielder, being a little earlier than the Boone County White, and later than Silver Mine and Reid's Yellow Dent.. This makes it especially adapted to the central part of the corn belt.

Legal Tender was started towards that type which it now holds about 1876, by Nims Brothers, of Emerson, Iowa. They discovered two distinct types in their seed corn, one a short, thick ear, and the other a long, slim ear. By crossing these two types and following that with careful selection they originated the Legal Tender variety. This variety is restricted more or less to the district from which it came. It has never been widely distributed, and probably, with its present type, never will be.

Boone County White is one of the most popular corns of the country. This variety was originated by Mr. James Riley, of Boone County, Indiana. It was made by selection from a large, coarse corn of the time, known as White Mastodon. The type was established entirely by selection, and, soon after that, various breeders all over the central and southern part of the corn belt began to raise it.

Silver Mine was originated by Mr. J. H. Beagley, of Ford County, Illinois. The type was brought to a standard by several years of very close breeding. After that the Iowa Seed Company purchased the stock of Mr. Beagley and named the corn Iowa Silver Mine. It is characterized by the broad, deep kernel with a very rough dent. Often confused with this is the Silver King corn, which is entirely different, being much smaller and much earlier maturing.

Minnesota No. 13 illustrates what may be done by the effort of an experiment station. This variety was brought out by the Minnesota Experiment Station from some corn which they found in their locality. It has become very popular in those states where it is adapted, namely, Minnesota and the Dakotas. It is characterized by a deep kernel for the period of maturity which is required.

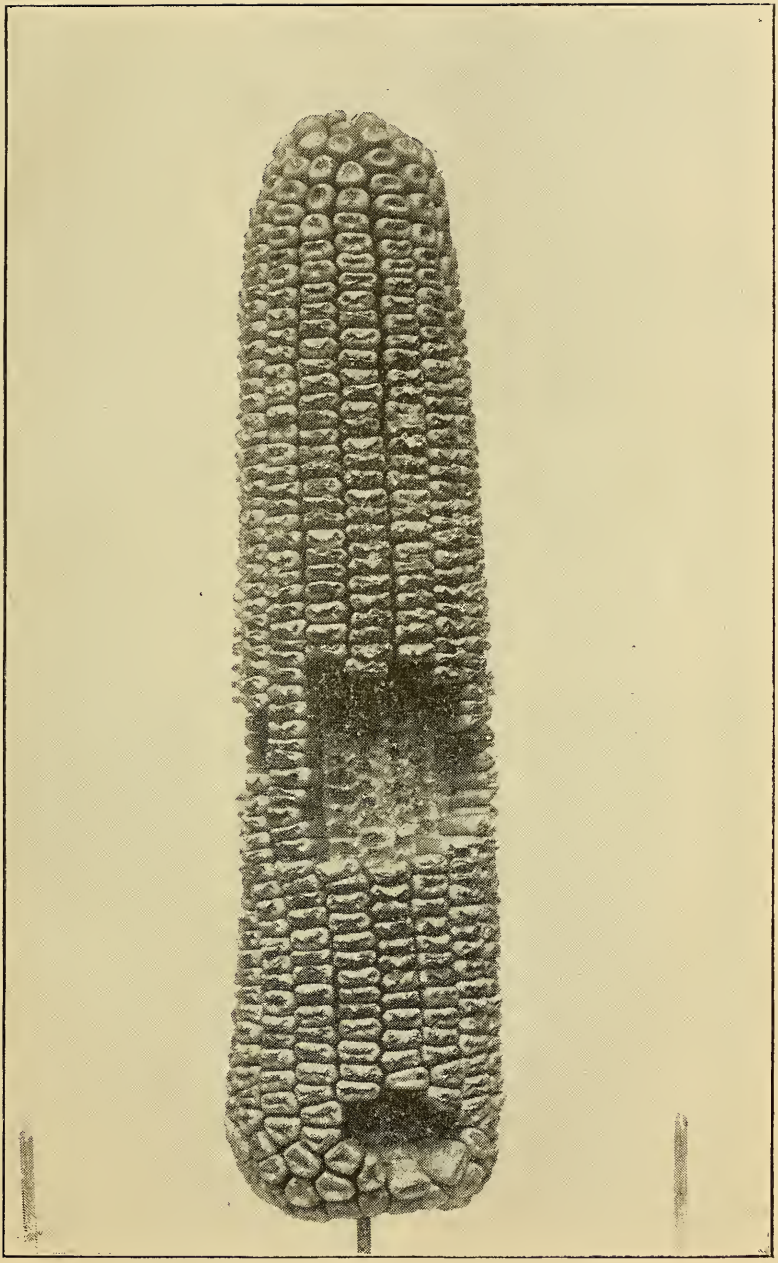


PLATE 11—SILVER MINE.—*Iowa State College*

Laboratory Exercise.

Secure three or four varieties of corn from the most convenient place and note carefully the different points as given in the outline above.

Variety Tests.

There always are, in the states where experiments have been in operation very long, variety tests being conducted. These tests, however, are the work of men who spend their entire time at such business and should not be attempted by the farmer. Corn variety tests are necessary in every community, for the results of one place will not apply to another. So it is much better for the farmer who has a corn of medium yield to select from that corn rather than to send to some distant place for seed on the grounds that reports from that place on the corn were large. Corn moved any distance, especially if soil and climate are different, will not do as well as corn raised in the immediate locality.

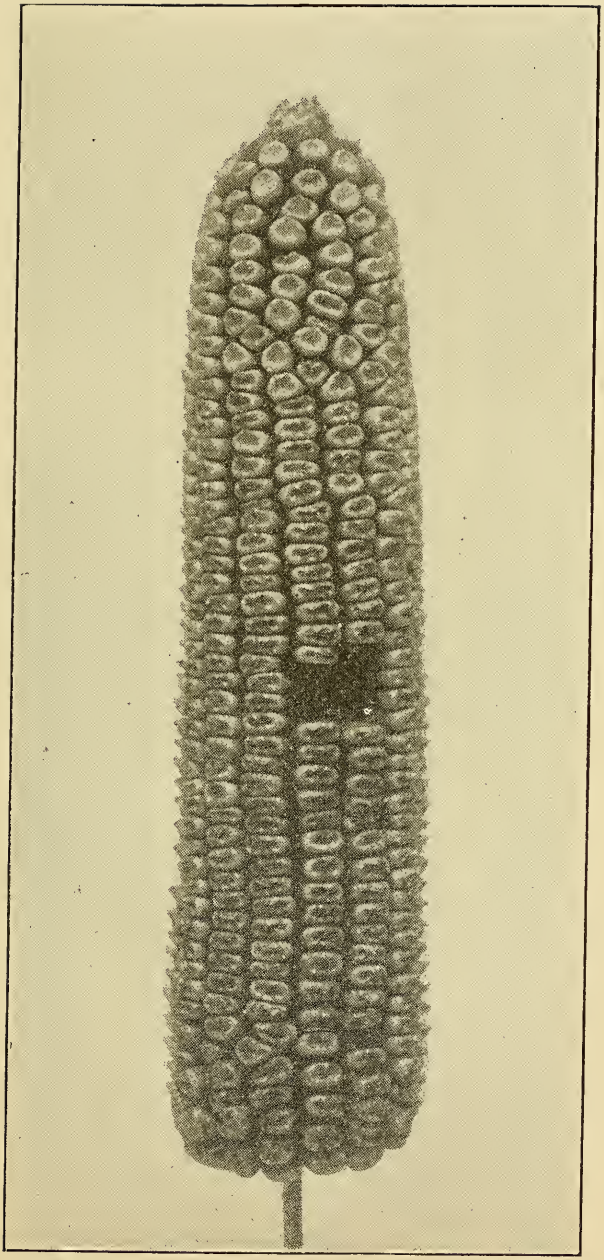


PLATE 12—PRIDE OF THE NORTH.—*Iowa State College.*

STANDARD OF PERFECTION FOR CERTAIN VARIETIES OF CORN

VARIETY	EAR			KERNELS					ROWS			BUTTS	TIPS	SHANK	COB		Per Cent. of Shelled Corn
	Shape	Length Inches	Circumference Inches	Condition	Color	Indentation	Shape	Length	Number	Space	Arrangement	Filling Out	Filling Out	Size	Size	Color	
1. Reid's Yellow Dent	Sl. tap.	9-10	6.75-7.25	Firm	Light Yellow	Med.	Med. Wedge	Long	18-24	Narrow	Pairs	Deep Rounded	Well Covered	Small	Med.	Deep Red	86
2. Leaming	Tap.	9-10	6.75-7.25	Firm	Med. Yellow	Med.	Med. Wedge	Long	18-22	Med. Narrow	Pairs Indistinct	Med. Rounded	Well Covered	Medium	Med.	Deep Red	86
3. Legal Tender	Cyl.	10-10.5	7.25-7.5	Med. Firm	Med. Yellow	Med. Rough	Med. Wedge	Long	16-22	Medium	Pairs Indistinct	Rounded	Well Covered	Small	Med.	Red	86
4. Boone Co. White	Cylin.	9-10	7-7.5	Firm	Cream White	Med. Rough	Med. Wedge	Long	18-22	Med. Narrow	Pairs	Med. Rounded	Well Covered	Medium	Med.	White	86
5. Silver King	Sl. tap.	8-9.5	6.75-7.25	Firm	Cream White	Med. Rough	Med. Wedge	Med. Long	16-20	Med. Narrow	Pairs	Med. Rounded	Med. Covered	Med. Small	Med. Small	White	85
6. Silver Mine	Sl. tap.	8.5-9.5	6.75-7.25	Med.	Cream White	Rough	Med. Wedge	Long	18-22	Med. Narrow	Distinct	Med. Rounded	Well Covered	Medium	Med.	White	85
7. Iowa Ideal	Sl. tap.	9-10.5	7.0-7.5	Med.	Pearl White	Med.	Med. Wedge	Long	18-22	Med. Narrow	Pairs	Med. Rounded	Well Covered	Medium	Med.	White	86
8. Johnson Co. White	Cyl.	10-11	7.5-8	Med. Firm	Starchy White	Rough	Wedge	Long	18-24	Medium	Pairs	Medium	Well Filled	Med. Large	Med.	White	86
9. Mosby's Prolific	Sl. tap.	8-9	6-6.5	Firm	Pearl White	Med. Smooth	Broad Wedge	Med.	10-14	Med. Large	—	Even	Medium	Med. Small	Small	Med.	84
10. Clarage	Sl. tap.	8-9	6.75-7.25	Firm	Med. Yellow	Med. Smooth	Med. Broad	Med.	14-18	Medium	Pairs	Med. Rounded	Med. Covered	Medium	Med.	Red	85
11. Minn. No. 13	Sl. tap.	7-8	6-6.5	Firm	Light Yellow	Med. Smooth	Med. Broad Wedge	Med. Short	14-18	Medium	Pairs	Med. Rounded	Well Filled	Small	Small	Red	85
12. Hickory King	Cyl.	8-9	6.5-7	Firm	Pearl White	Smooth	Very Broad	Med.	8-10	Med. Wide	—	Even	Medium	Medium	Small	White	84
13. Hildreth	Sl. tap.	10-11	7.5-8	Firm	Deep Yellow	Med.	Long Wedge	Long	18-24	Med. Narrow	—	Med. Rounded	Medium	Med. Large	Med. Large	Light Red	88
14. Pride of the North	Tap.	7-8	5¾-6.25	Firm	Med. Yellow	Med. Smooth	Med. Wedge	Med. Short	16-20	Medium	—	Med. Rounded	Well Filled	Small	Small	Red	(Med.) 88
15. Golden Beauty	Sl. tap.	10-11	7-7.5	Firm	Deep Yellow	Smooth	Broad	Med.	12 14	Med. Wide	—	Even	Medium	Medium	Med.	Red	84

TABLE V

EXAMINATION

Note to Students—These questions are to be answered independently. Never consult the text after beginning your examination. Use thin white paper about 6 in. x 9 in. for the examination. Number the answers the same as the questions, but never repeat the question. Mail answers promptly when completed.

Questions on Lesson I

1. What place does America hold among the nations of the world in the production of corn? Give approximate figures.

2. Where does the United States stand as compared with the other countries of this continent? Give figures.

3. What is the average yield of the United States, bushels per acre?

4. What is the average yield per acre in your state? In your county?

5. Has the average yield of corn per acre increased or decreased in your state? How do you explain this?

6. In the United States what can you say as to the place of corn among the other cereals?

7. Where did corn come from? Discuss.

8. Where do we learn first of corn being produced in the United States or in the country now occupied by the United States?

9. Of what benefit were the Indians to the white men as they began to grow and cultivate corn?

10. How long have European countries been cultivating corn?

11. From what plant do we think corn came?

12. How do you explain the fact that the tassel is at the top and ear at the side of the stalk?

13. What features, as corn is noted in the field, lead us to believe, as we do today, about the origin of the corn plant?

14. What do you understand by "a grass"?

15. Tell whether the following are grasses or not: wheat, oats, corn, clover, alfalfa, buckwheat, timothy, dandelion.

16. Draw a diagram of the kernel of corn, naming the parts.

17. Describe the germination of the kernel of corn.

18. How do the roots start from the kernel, and what names are given the various kinds of roots?

19. Explain how the stalk is made up.

20. Give five ways the plant has of protecting itself against the wind.

21. Of what uses is the pith? The fibro-vascular bundles?

22. What sort of a root system do we want, and why?

23. How does the plant feed?

24. What is chlorophyl, and how is it used?

25. Describe the tassel and the developing ear.

26. How is the pollen of the corn plant distributed?

27. To whom do we refer for the classification of varieties and types?

28. What is a type? A variety?

29. Name the types of corn.

30. Distinguish between each.

31. What qualities would you think ought to be possessed by a good feeding corn?

32. What corns are of commercial importance?

33. What are some of our most common varieties? Name eight.

34. How would you distinguish Reid's Yellow Dent from Leaming?

35. Give the history of Reid's Yellow Dent.

36. Give the history of Boone County White.

37. From what three sources do our varieties come?

38. If varieties are to be compared, what is essential?

39. What do you understand by "variety tests"?

40. When will a high yielding corn be of little or no use to the farmer?

Write This at the End of Your Examination

I hereby certify that the above questions were answered entirely by me.

Signed----------

Address----------

The Correspondence College of Agriculture

CORN—PART TWO

THE

Correspondence College *of* Agriculture

FT. WAYNE, INDIANA

CORN—Part II

Corn Culture

By HARRY B. POTTER, B. S.

Assistant Professor of Farm Crops
in Iowa State College

This is the Second of a Series of Four Books giving a Complete Course of Instruction on Corn.

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The CORRESPONDENCE COLLEGE OF AGRICULTURE

NOTE TO STUDENTS

In order to derive the utmost possible benefit from this paper, you must thoroughly master the text. While it is not intended that you commit the exact words of the text to memory, still there is nothing contained in the text which is not absolutely essential for the intelligent corn grower to know. For your own good never refer to the examination questions until you have finished your study of the text. By following this plan, the examination paper will show what you have learned from the text.

The Photographs used in this book were obtained through the courtesy of Iowa State College

Part II—CORN

INTRODUCTION.

The production of a large amount of good corn during any given season does not depend upon any one factor. It depends upon a great number of considerations, the absence of any one of which will cause a loss to the individual concerned. The subject of this second study in corn has to do with the factors leading to a high yield of corn. Of course, our object in studying corn, no matter what line of work we are following, is to learn how to secure a greater number of bushels to the acre; but when we speak of "corn culture," we think of those things which affect the crop directly, such as the plowing of the ground, the preparation of the seed bed, the selection of the seed corn, and the methods of handling that seed corn before it is ready to be put into the field. So Corn Culture has to do with those things that the average farmer meets in every day life; those things which cause so much trouble if not cared for properly, and give such satisfaction if followed correctly. Of course many counties of every state are now interested in local corn shows of some kind and these shows exhibit corn which is of a certain type or variety, and the men exhibiting those varieties say that that corn is the best for their conditions because it yields the most. In most cases where these local shows are held, we find table after table covered with fine corn which is said to be high yielding. For example; word has just come to the writer's desk concerning a local corn show for a town of about three thousand inhabitants, the corn being sent to this show only

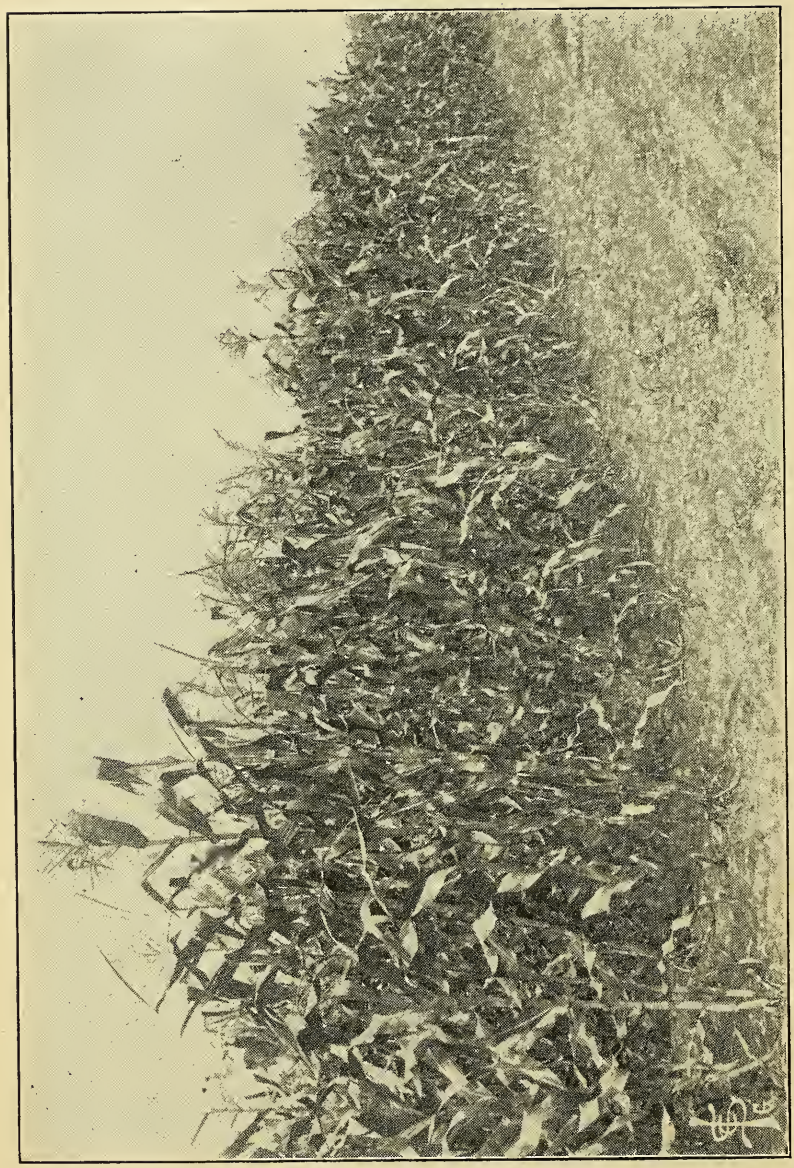

PLATE 1.—The Time to Study what your Corn is Doing is while it is Growing.

by those farmers who traded at the town itself. As a result of a little work of this kind, there were shown 217 entries which amounted to 3186 ears. This is but one example, among hundreds, of the interest that is being taken in corn shows and corn judging over the country, but this in itself only helps toward the greater work which this study aims to consider.

The object of corn breeding comes to the attention of every man who is raising any corn at all and it is a subject that is worthy the study of any one. Men are working in this country, and in the countries wherever corn is grown, to produce, by up-to-date methods, those types of corn which will yield the highest; because after all is said and done, it is the yield that the farmers of the country desire.

But after we have considered these methods of breeding and perhaps have put some of them into practice on the farm, there are still the problems remaining which are those of more practical and immediate importance, and those problems come under the subject of corn culture. It might be added also that the subject of the history of corn, the origin of the corn plant, and the botany connected with the growing of such plants as corn, are of interest to most people because of the relation that such facts have to the growing of corn itself from the commercial standpoint. For example, we take the common everyday fact that the farmer notices when he is in the field, that of the production of silks from the young and developing ear of corn. The farmer who is after the bushels per acre does not particularly want to know what the silk is made of, how it acts in order to produce kernels on the cob, of what value the pollen is as it falls on the silk, and such things as that, but if he knows these things as they were taken up in study I., he will know how to handle his crop in a much better fashion than if he went at the work blindly.

So we might define culture of corn as the immediate work which is done to produce immediate results; remembering that a knowledge of these other items, which do not bear directly upon the work in the field is necessary if the so-called cultural methods are to be followed wisely.

LOW YIELDS.

The fact that there have been a great many high yielding pieces of corn in almost every community does not cover up the fact that there are a great many pieces where a low yield of corn predominates. Take for example the figures which were given for the year 1909. It is noticed that the average yield per acre for the United States was 25½ bushels. Anyone will admit that this was a low yield of corn, and the corn grower will always make the statement that if he could not grow more corn to the acre than that, he would quit his work. The figures given in connection with corn growing in the United States showed that at no time for a period of ten years had the yield per acre been over twenty-eight bushels. If this is true, and there is no doubt but that it is, there must have been, somewhere, some very poor corn in order that the average would be pulled down so low.

Corn experts all over the United States have tried to solve the problem of why so many acres were wasted in the raising of corn, and the work that they have done would seem to indicate that there are five main reasons why corn does not yield as well as might be expected.

Reasons for Low Yield. Low yields of corn will be due to one or more of the following facts:

1. Varieties of corn not suited to the conditions where grown.
2. Poor seed.
3. The faulty handling of good seed.
4. Poor seed bed.
5. Seasonal influences.

It will be noticed as these items are considered that there is only one beyond the control of the farmer, and that one is the last. But if the farmer loses a crop of corn, in nine cases out of ten he will say that the season was to blame for it, while it might have been that one of the first four factors, for which he was responsible, and which he did not take care of properly, was at fault.

So the work of this study will be to consider just what can be done with the first four items in order that maximum yields will result; and just what influence the season will have upon the results of our work.

THE SEED.

Within the last fifteen or twenty years, a great deal of importance has been given to the selection of proper seed for the growth of all of our farm crops; and rightly so, because if all the other factors of a high yield of the crop are present and poor seed is put into the ground, there can be but one result and that will be a disappointment to the grower. In fact, if we drop out any one factor, the other factors are not complete enough in themselves to produce the results which would be expected. But this item of the seed, which has caused so much concern, especially with corn, during the past few years, seems to be more important and fundamental than some of the other matters. For example, it is altogether possible to have a fair yield of corn in a medium grade of soil, but just as soon as we have a poor ear of corn in the fourteen which are necessary to plant the acre, just so soon is the yield per acre of our corn reduced very materially.

Suitable Varieties.

A few years ago it was not thought of serious consequence to change corn from one locality to another; but there is hardly a farmer nowadays who does not realize that if seed corn is purchased from some place other than where the corn is expected to be grown, the results in the field will not be at all satisfactory. Every Experiment Station in the United States where corn is raised as a crop has shown very plainly this fact to be true; namely, that if corn is moved out of the climate, or off from the soil, where it is accustomed to grow, it will not yield as much mature corn as it had been in the habit of yielding in the place from which it came. For example, when Johnson County White corn was so popular because of winning so many premiums at the National Corn Shows, men from every state in the union decided that they wanted to raise Johnson County White and they proposed to order some. Railroad men thought that they would be doing a great thing for the country if they distributed this prize-winning corn over the territory through which their railroad ran; and so both north and south there were men growing Johnson County White or trying to

grow it; many of them with complete failures from the start. But those, who were successful the first year, soon found that that variety of corn would not be successful under their conditions. In most cases, there were two conditions which were violated; the soil and the climate.

Corn ought to be raised on the same kind of soil and under the same climatic conditions year after year if the very best results are to be obtained. So a man in some part of one state can not hope to get, in most cases, the results of his friend in some other part of the state unless he grows his own corn. Or, to express it in the more common language, it does not pay to move corn north or south, from one soil to another, nor east and west very great distances unless the soils are identical.

So in considering the varities which are adapted to the locality where the corn is desired, the fact of the environment of the seed must be taken into consideration. It might be added here that if any one desires to introduce a new type of corn, that can be done; but it requires six or seven years of patient work to get the corn acclimated; and that is, of course, not profitable for the man who wants to get quick returns from his investment.

SELECTION OF SEED CORN.

It is a pretty safe plan, then, to select seed corn from the home field for the reason that better results will be secured than if seed is imported from any distance. Of course, if it is impossible to make the home farm produce the seed that you want for a given year,the next best thing is to secure seed from the nearest place where the type of corn that is desired is grown. If seed companies are relied upon to secure the seed, it would be well to check their work as carefully as possible in order to know that the guarantee of the seed house is really worth what it claims to be. Or, to say it in another way, if seed can not be secured where the eyes of the purchaser can see it on the stalks in the field, it will be well to use every precautionary measure before the sale actually takes place. But in the work of the study, we will assume that the corn is taken from the home fields. Then the matter of varieties will

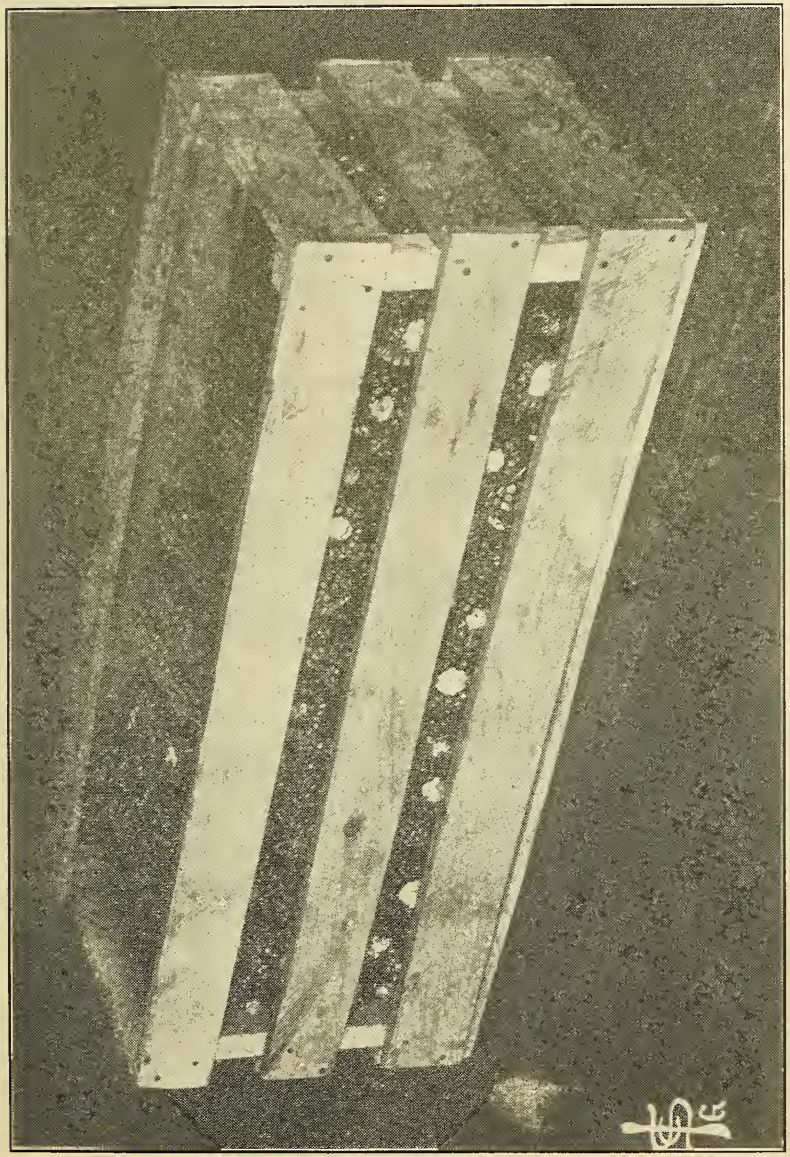

PLATE 2—A Good Way to Ship Seed Corn

not bother to any extent. Varieties are important, but in many cases the variety which is best suited to one place is uot suited to another.

Selecting From the Home Field.

In selecting seed corn from the home locality, there are just three ways possible; first, to select from the crib; second, to select from the field at the time of husking; third, to select the seed corn before the time of husking by entering the field and noticing the ears as they have developed on the stalk. The advantage of the first method is plain. It requires less work to select from the crib, providing the man who is doing the selecting is not particular what kind of corn he secures, and usually he is not particular, if he waits for the crib method of selection. There is the large disadvantage in this method of finding very many of the ears molded or rotten or damaged by the frost to such an extent that even though they happen to be good ears of corn they are worthless from the seed standpoint. Another disadvantage of this method is that the ear in its relation to the stalk can not be known. Nowadays the stalk is watched by those men who make a very careful study of the subject of corn.

The second method which is possible for the selection of corn, that which would select from the field at the time of husking, is a quick method but has the disadvantage of very often securing ears for seed which have been damaged by the frost or rain so that their germinating powers are not high. This method, however, will remain a very good method for practical purposes, but will, no doubt, be soon followed on most of the farms of the country by the third method, which would undertake to select the corn from the field before the first heavy frosts come. This is ideal and where it is followed to any extent meets with a great deal of success. Really, the last method is one which every farmer can follow; and directions will be given here only for this one practice, for those who are working constantly with corn know that there are few if any farmers who can not select their corn from the field. Of course,if the last method can not be followed for some reason peculiar to the farm where the work is being done, the method of

putting a box on the back of the husking wagon and collecting the best ears at that time is better than not selecting from the field at all. In fact, fairly satisfactory results have been obtained in this way, but by far the most of the successes have come from those who select early in the year.

Method of Selecting Seed Corn.

In the first place, if the farmer does not have a special part of his field which he is devoting to the raising of seed corn, it will be necessary for him to use the general field from which to make his selections. The date of the first killing frost for the average year is usually known in every community, and the selection of the corn should be done before this first killing frost comes. To wait until after the killing frost, means to lose a great deal of the benefit which comes from the field method of selection.

In the states where corn is made the main crop of the farm, there is usually set aside a certain period of time in which it is recommended to select all corn intended for seed purposes. For example, South Dakota sets the date September 10th as the last date on which any corn should be picked; Minnesota says September 20th; Iowa says the last ten days in September; but all states, where the frost is apt to affect the work at all, empasize the point of selecting this corn early. The reason is that if corn is left in the field subject to the weather conditions, the germination is apt to be very poor. After the date is well in mind and plans are laid to select the corn according to these directions, the farmer will prepare himself with a grain sack which he can easily tie over his shoulder by a piece of binder twine or something similar.

As he enters the field to do this selecting, he will have no team to bother him, no wagon to be in the way, but can spend all of his time in noticing the points of the stalk and the ear as he could not in any other way do. Passing down between two of the rows, he can notice on both sides whether there are any ears born at the height he desires. It is definitely known that the higher the ear is produced on the stalk, the later is its maturity. So, in the states where early maturity is a prominent factor in the pro-

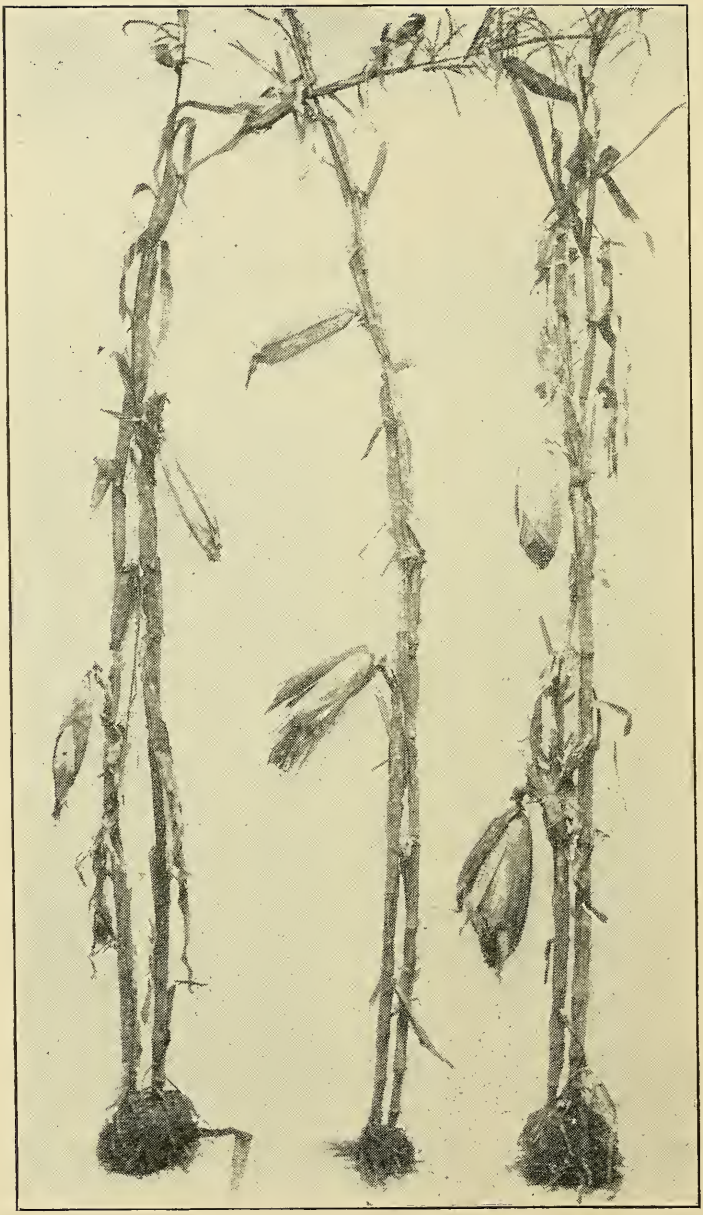

PLATE 3—Stalks Showing Different Characters

duction of good corn, this fact must be realized. As the breeder moves along in the field making his selections, he will notice the kind of stalk on which the ear is grown; whether the ear hangs at the angle he desires or not; whether the husk fits tightly or not; how tall the stalk is; and such points as these which are going to affect the development of a corn such as he will desire.

Then, after the points of the stalk are noted, by pulling the husk back a short way the tip of the ear which is enclosed can easily be seen. If it suits the farmer to any fair degree, he can pick it and put it in the sack which is hanging on his shoulder, and go on looking for more ears having the same qualities that the one just selected had.

This will be no easy task. It will require patience and time, but the man who is in earnest for better corn can well afford to put in this time to get the results which he could not get otherwise. It may be that in going over a field of ten or fifteen acres, there will only be twenty or twenty-five ears of the type that he desired, but if these are selected carefully, it will mean that a start has been made toward a much better crop of corn in the years to come. In all of this work it must be remembered that a rapid change can not be made within a year's time, for nature does not permit any such wonder changes.

Just what the points of the ear and the stalk are and how the farmer may learn to notice these things as he is moving through the field will be taken up in another study.

STORAGE OF SEED CORN.

After the seed has been carefully selected, the matter of proper storage comes up for attention; and it is a matter which needs to have the consideration of every one because a high percentage of the failures in growing corn are due to the fact that while the corn was being stored, improper conditions were brought near it in one way or another and the vitality of the seed was injured. Our grandfathers and great grandfathers used to take two ears of corn, tie them together by the husks, and throw them over the rail fence, or a wire, where they might dry. The principles involved in

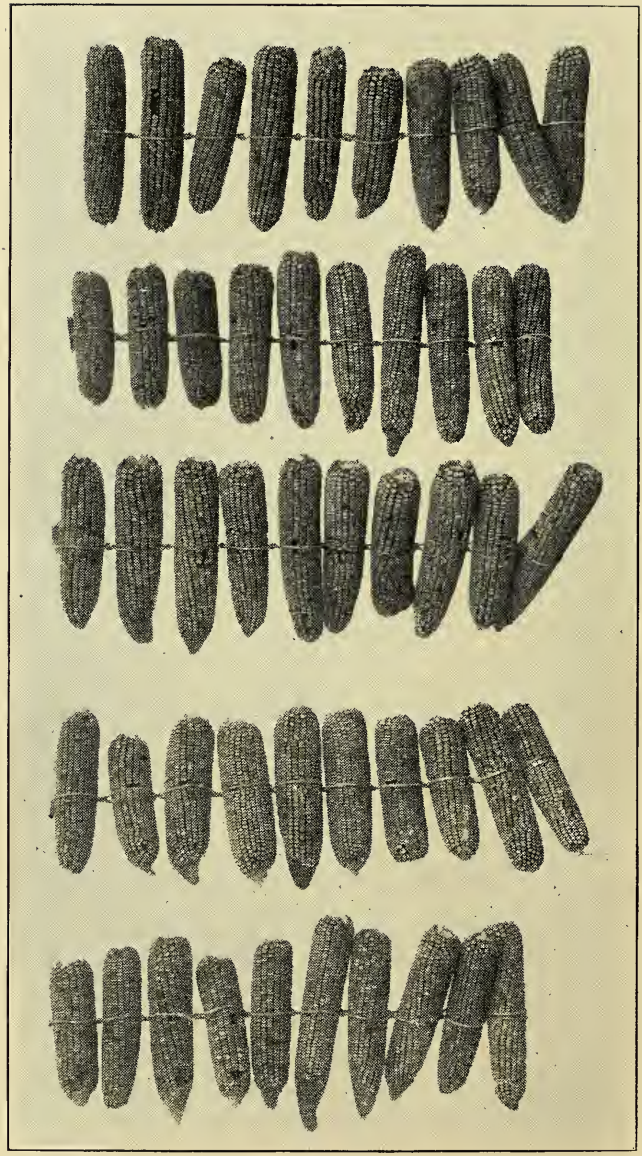

PLATE 4—Not a Bad Way to Hang Seed Corn

PLATE 5—Beginning the Double String Method

taking care of seed corn in this way are not far different from what we have today. But today we have newer and more up-to-date methods of accomplishing the same purpose. Manufacturers of farming implements began, as soon as the idea of good storage became prevalent, to manufacture devices which would keep the grain as was desired. There was just one thing to accomplish,

but that one thing was very important; and that was that each ear should have a free circulation of air of moderate temperature around it. Or in other words, each ear of corn must be supplied with an atmosphere around it that will take out the excess moisture and still not injure the tender germ within each kernel.

Likewise the experiment stations have been working on something that would fit the conditions and allow the ears to be accessible at any time during the period of storage. Various methods of hanging ears by strings have been devised and the common method of tieing a string around the central part of the ear and follow that by another ear with the string tied around its central part, and another with a string tied around it, and so on until twelve or fourteen ears are hung together is not a bad plan. Another plan has been devised which gives good circulation of air to the various ears. That method uses a piece of binder twine perhaps sixteen or twenty feet long tied together and the ears placed in the double piece of twine as it hangs from the two hands of the man who is doing that part of the work. Another man places the ears one by one in the double cord and the man with the string passes his hands through and through as the ears are placed in their positions. The man who is working with the cord holds tightly with his foot on the ear which is lowest. This holds the string very tight and in so doing makes an orderly piece of work.

It does not matter, though, what system is followed, providing the method allows the free circulation of the air, as already indicated.

The most important factor with which we have to deal in the storing of corn is the moisture content of that corn. The following table which was worked out by a couple of men at Iowa State College several years ago illustrates the amount of water that was found in the crop at various seasons of the harvesting period.

DATE—	KERNELS	COB
September 14	41.78%	58.58%
September 21	37.35	57.17
September 28	33.04	55.86
October 5	28.52	52.28
October 12	25.97	49.05
October 19	20.15	40.99
October 26	22.09	37.24
November 2	17.83	26.82

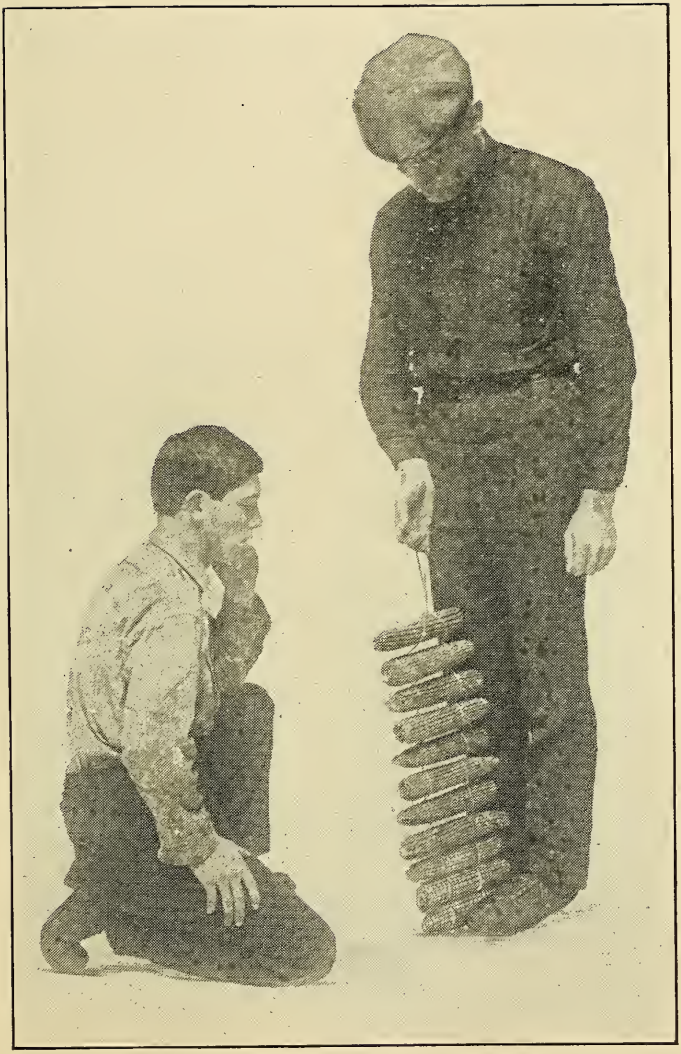

PLATE 6—The Ears are Ready to be Hung Up

If the moisture is removed as rapidly as possible without applying a direct fire to the ears of corn, results are very satisfactory. Really, the first few weeks of the storing process are more important than all the rest of the time combined, as in that time a large percentage of the moisture leaves the ear. When that is accomplished there is not much danger of cold or heat injuring the germ.

The question naturally arises just where we can store this seed corn in order to get the results which have been mentioned. After a proper system of hanging the ears is discovered and it becomes necessary to find a place suitable for putting into effect these ideas it is always anything but advisable to put seed corn over stalls or mangers or small grain bins or anywhere that the moisture from these other things is apt to collect on the corn and mold it. It has often been recommended that the best place for storing is the attic over the ordinary living room. But as a good many homes are not equipped with an attic suitable for this work, it becomes necessary to look for a seed house or a tool house or some building of that kind where the evils will not be present.

Another student at Iowa State College who did a great deal of work along corn lines experimented with the problem of how to store corn to the best advantage. After much detailed work had been accomplished by him and after his results were considered for some time, the following conclusions were drawn.

First, high temperature and low humidity, as were the conditions in the green house, are detrimental to the vitality of seed corn.

Second, low humidity and average room temperature, as illustrated by results obtained from corn stored in the Farm Crops Laboratory, are also injurious to the seed.

Third, high humidity and somewhat low temperatures are not so detrimental to corn as somewhat high temperatures or low humidity as shown by results of corn stored in the basement of the Agricultural Building.

Fourth, average humidity with low temperature, as shown by results of corn stored outside, show less ill effects than high humidity and low temperatures.

Fifth, average humidity and average temperature, aided by good ventilation, as illustrated by results of corn stored in the attic, give the best results.

Sixth, the amount of moisture present in the corn and that present in the atmosphere have more influence on the vitality of the seed than the degree of temperature.

Working along this same line, some other men found some results which were very similar in character to those which have been mentioned and the conclusions they drew were:

First, when very full of moisture, even freezing for a short time is detrimental.

Second, excessive moisture when not attended with low temperature also weakens vitality. So, considering these facts, the importance of proper storage is apparent.

SELECTING THE TYPE.

After a great many ears have been selected and stored as has been indicated, and the time comes to arrange these ears for planting, we will say about the first of March or a little sooner, it becomes necessary to pick out the ears that we want for seed from what we call the type standpoint. A later study will indicate a little more what is meant by selecting an ear for a certain type, but taking for granted a farmer knows what he wants along certain lines, the method of getting at the result is what will be considered here. In the first place, there is no room in the house or in the barn or anywhere on the farm that is too good for working with the seed corn in it. The ears of corn ought to be laid out after they are perfectly dry, side by side with the butts of the ears toward the man who is doing the work. Perhaps these ears will be laid out on the floor, or there may be room on the work bench for the ears which have been thus far selected. But in most cases there will be too many to have any place for them on tables, and so the floor can be easily used. If the floor is of such a character that it doesn't matter if a nail is driven into the wood, it would be well to take these ears and by means of nails tacked in at the ends of the columns to make the ears stationary or so that they will not

PLATE 7—The Only Way to Study the Ears is to Have Them All Laid Out

shift about. Then the man who is doing the selecting can go through carefully and we will say that there are several ears he does not like at all from the type standpoint. These may be thrown out. There may be others that are partially satisfactory and so they will just simply be pushed out a little to indicate that they will not be used unless it is absolutely necessary to do so. After this is done and the number of ears are reduced to perhaps double the number that are actually needed for planting the next year, the seed is ready for testing.

TESTING CORN.

In the first place, it is necessary to test corn before it is put into the field. It is not uncommon to hear men say that they can tell by looking at an ear of corn whether it will grow or not. But as a matter of fact, they probably have no more insight into this matter than have the hundreds of men over the country who are working every day with corn. The case recently came to the writer's notice where out of six bushels of corn which had been shipped out of a farm seed house for good seed corn, only one ear would grow, notwithstanding the fact that almost every ear looked, even after the germ had been cut open and examined carefully, as if it would grow. So it is necessary, from the standpoint of knowing whether the corn will grow or not, to test it. And of course it is easily recognized, without any experiments to show the fact, that unless the corn will grow it will not produce a good stand; and unless we have a pretty good stand, we can not expect a good yield. We mean, of course, by a good stand of corn that which will produce the greatest possible yield. And if it is found that, for the conditions under which the farmer is working, three stalks to the hill are desired, anything short of that reduces the perfectness of the stand. No absolute rule can be laid down for any section in regard to this point. But if the seed is found to be poor in germination, a good stand can not be expected. The following tables illustrate the point that the yield per acre will be influenced directly by the per cent. of the stand and of course it is easily seen how the per cent. of the stand is regulated by the germination powers of the seed.

Stand and Yield

The following test was conducted in 1906 in one County of Iowa.

TEN HIGHEST YIELDING SAMPLES		TEN LOWEST YIELDING SAMPLES	
Per Cent. Stand	Bushels Per Acre	Per Cent. Stand	Bushels Per Acre
78.1	86.0	43.8	46.7
64.8	85.3	79.1	47.4
87.6	84.0	54.8	51.3
85.4	82.6	50.2	51.7
88.8	80.8	76.7	55.8
89.4	80.1	41.9	56.9
78.7	78.1	61.1	57.3
84.6	78.0	94.8	58.1
92.4	77.2	85.0	58.6
87.3	74.8	77.8	59.3
Ave. 83.7	80.7	66.5	54.3

Perhaps the question will arise here as to what we mean by a stand of corn and how we may determine whether that corn is what we desire or not. A man passing by the roadside glancing into a field of corn will more often estimate the stand of corn higher than it is, than he will lower. It is impossible to get a perfect stand of corn, but of course a great deal can be done toward that end. A man who desires to ascertain what his field is doing can enter the field at any point and if the field is check-rowed the best plan will be for him to work diagonally across the field. In this way he will not be drawing conclusions from the wrong data. If he followed the row straight down, in all probability some defect of the planter or of the method of putting the seed into the ground would affect his ideas. He will go along hill by hill and count the stand and perhaps he will get results something like this:

3—3—1—2—3—1—1—3—3—2—4—
4—2—3—1—3—3—2—3—1—1—3

Or it is possible that figures like the following will be the result of his count:

1—1—0—3—1—2—3—0—0—3—1—
2—3—1—0—1—1—2—1—3—2—0

In the first case, the stand was surprisingly uniform; in the second case, the reverse. But these figures are exactly what can be found in a good many fields over the country and resulting from this uniform stand the average for the United States has been reduced to around twenty-six bushels per acre. With these figures in mind,and remembering that the greatest part of the poor stand is due to the fact that the seed would not grow, it becomes compulsory to test seed corn.

There are two ways that this corn may be tested. The ears of corn which may have been selected may be shelled together and, if the grain is well mixed, a representative sample may be taken from the whole lot and perhaps duplicate samples of one hundred kernels each tested in a germinator of some kind. When the germination of this grain is read, it will be noticed that perhaps in one case ninety-eight out of the one hundred kernels germinated. Of course the farmer can go ahead with such grain and plant it. But his neighbor may under this test have fifty per cent. vitality shown. This would mean discarding entirely the seed corn which has been prepared and going elsewhere to purchase new corn which as has been stated before, is a very doubtful practice. Instead of shelling the ears as above indicated, the corn may be tested by selecting a few kernels from each ear and all of these kernels put in the test. In either case we can term the method a general one for the testing of seed corn.

By far the best method is that which is known as the individual ear test. The ear of corn, in this kind of work, stands out as the unit of our endeavors. And by testing kernels from individual ears, and by keeping a record of these individual ears, we have an exact basis from which to work. So the advice can safely be given to test each ear of corn before planting; not in a general way but in a definite way so that an ear itself, if it is dead, may be discarded. Whereas, if it were tested in a general way, there would be no way of discarding a bad influence of this kind.

The method of testing these individual ears follows:

The ears of corn are laid out side by side for the work. Then the preparation of a germinating box is the first matter to be considered. It is true that there are on the market at the present time

several makes of germinating boxes. But there is no form which exceeds the value, (as far as learning what the corn will do), of the ordinary sand or sawdust box which anyone can make. It would be going into a great deal of detail to give the method of making the various forms of seed corn testers, but the following description and illustration which was furnished in a bulletin by the Purdue Experiment Station at LaFayette, Indiana will answer the purpose here. This sand box has proven itself very efficient in determining whether the ears of corn will grow or not.

"A convenient tester, and one which we would strongly recommend every farmer to use, is shown in the illustration below, and may be made as follows: Take ordinary inch lumber and make a shallow tray of convenient size, say about two by three feet, and two and a half inches deep. Then bore small holes through the sides and ends about two inches above the bottom and about an inch and three-quarters apart. Through these holes string light galvanized or copper wire in both directions. Then fill the tray up to the wires with sand, earth or fine sawdust. Sand is preferred, because it is clean and easily kept in good condition. Each square marked off on the surface by the cross wires is intended for the kernels from a single ear of corn. Instead of weaving in the cross wires as indicated, a piece of large meshed wire chicken fence may be fastened in. If this is preferred, the tray should be made two inches deep, then the piece of chicken fence fastened on top, and a half-inch strip nailed on top of that so as to raise the edges of the tray half an inch above the wire netting, as in the other case. After the tray has been filled up to the wire with sand or other material as directed above and thoroughly moistened, the tester is ready for use. If much corn is to be tested, several of these testers should be provided. They are easily made, and with good care will last many years. For the average farmer one will be sufficient, as about three bushels of seed ears can be tested at one time.

"When making tests, some convenient system of arranging the ears on a floor, table, shelf or rack must be employed, so that the ear corresponding to a certain square in the tester may be readily located. Begin filling the tester by placing five kernels from the first ear, selected as directed above, in the first squares

at the upper left hand corner, and fill each row of squares in regular order.

"After the kernels have been placed, the material in the tester must be kept thoroughly moist. Some kind of cover must be used to keep the surface from drying, and if this is properly done the kernels need not be buried out of sight. Some kind of a glass plate or frame makes the most satisfactory cover. This should rest loosely on the edges of the tester, so as to admit some air. With such a cover, the soil need be moistened only once for each test, as the evaporated moisture will condense on the surface of

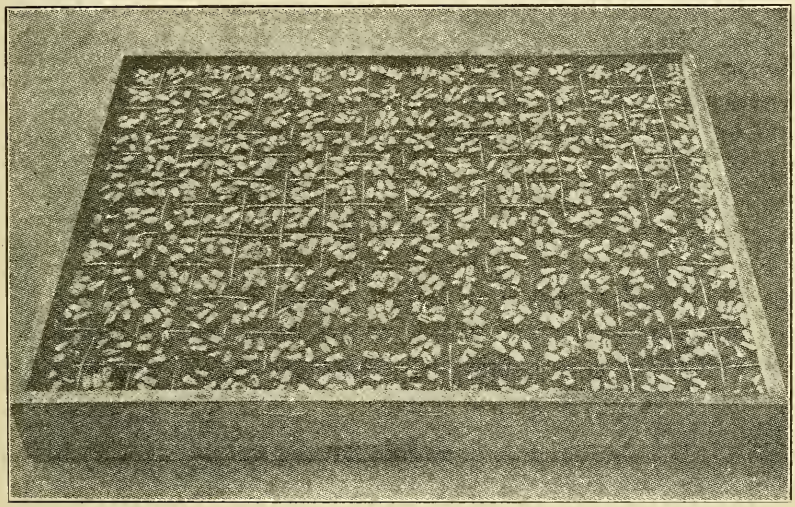

PLATE 8—A Convenient Germination Box.

the glass and drop down again. When moistening is necessary after the kernels have been placed, a towel or other cloth should be placed on the surface and the water poured gently on top. If this is not done, the water poured on will move many of the kernels out of place.

"The tester should be placed in a room ranging around 70 degrees F. in temperature, as stated above. All kernels which do not send out vigorous root and stem sprouts within seven days, under these conditions, should be considered too weak to germinate properly under ordinary field conditions. If the germination

of any lot of kernels is unsatisfactory, the ear from which they came should be discarded. About 95 per cent. of the kernels should germinate strongly within the seven days.

"The seed corn tester should be as important a part of the corn grower's outfit as the planter or cultivator, and its use should never be neglected. A handy person can easily make an individual ear test of five or six bushels in a day, and the labor involved will be paid for many times over in the better stand of plants and the consequently larger crop secured."

The details of the work which this account gives makes the matter of testing the corn very plain, but there is one more point which ought to be emphasized, which is not mentioned in these paragraphs; and that is the fact that the ears which are under test should be very carefully handled so that when the test is done the proper ears can be easily located. Probably the best method for accomplishing this result on the average farm is by means of a nail driven between each ten ears. That is, as the ears are laid out one after another the farmer will commence to count from left to right one to ten; drive a nail or two in the floor or plank on which the corn is lying; count off ten more ears and drive another nail; count off ten more and drive another; and so on until all the ears are separated into groups of ten.

The testing box will be arranged, if thought is taken before hand, so that there are across the top of the box ten divisions or squares. The kernels from ear No. 1 will go in square No. 1, and kernels from ear No. 2 in square No. 2, and so on across. In this way there is no danger of making a mistake. Since there is always danger of mixing the ears in some way, it is usually best when working with a certain ear to push the ear, next to that one, up next to the others, so that if the others roll into the place of that which is being used the error will be noticed at once.

The test will occupy about six or eight days. At the end of that time, the question comes; what ears are the ones that are desired and what are not, as shown by the germination of the kernels? The photograph of the germinating kernels of corn and the explanation with that photograph indicate how the reading ought to be made and what those readings mean. When it is dis-

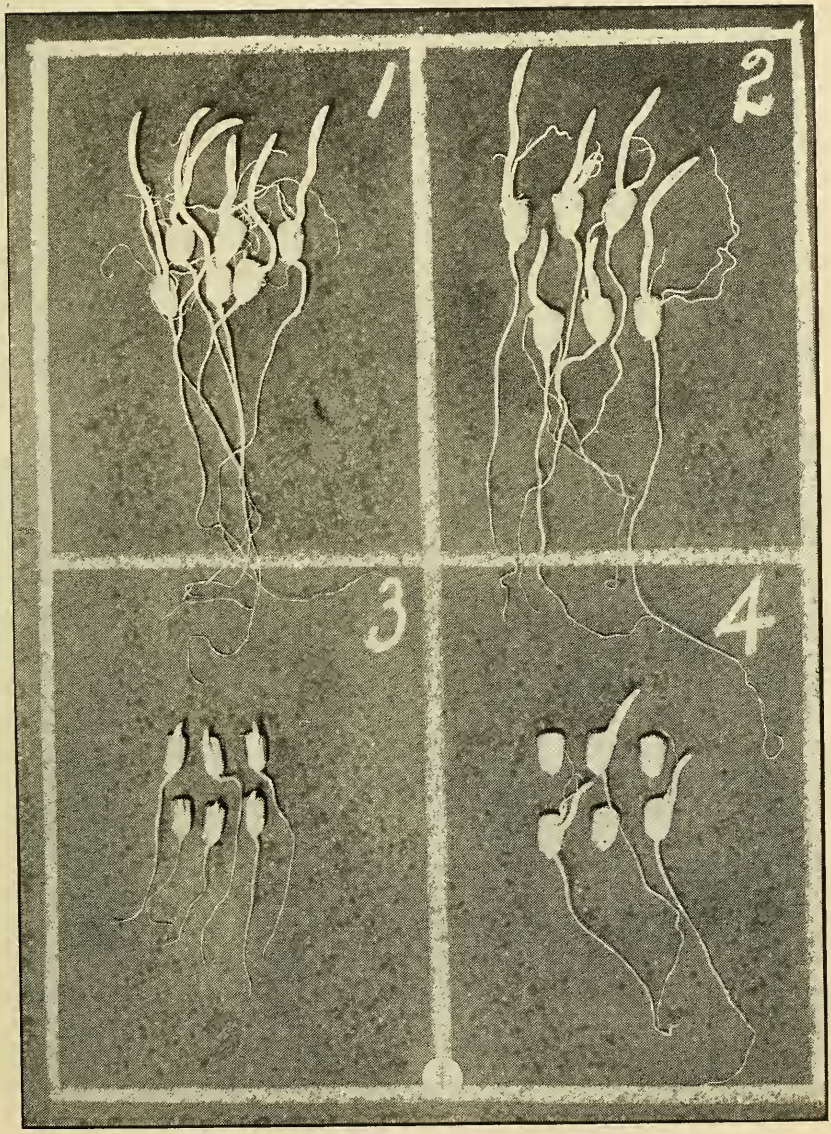

PLATE 9—The Germination Box Will Show the Good and the Bad Kernels

covered what kernels are the bad ones, the ears from which they came can be discarded at once and only the ears which show a germinating power of the very strongest type will be used.

Then comes the work of grading the corn and getting it ready for the planter.

GRADING THE SEED CORN.

The first operation of course is the shelling of the ears, which may be done by hand, but if a corn sheller of small capacity is available, that will be satisfactory. The butt and tip kernels are usually shelled off before the main ear itself is shelled. The reason for that is that the butt and tip kernels are irregular in

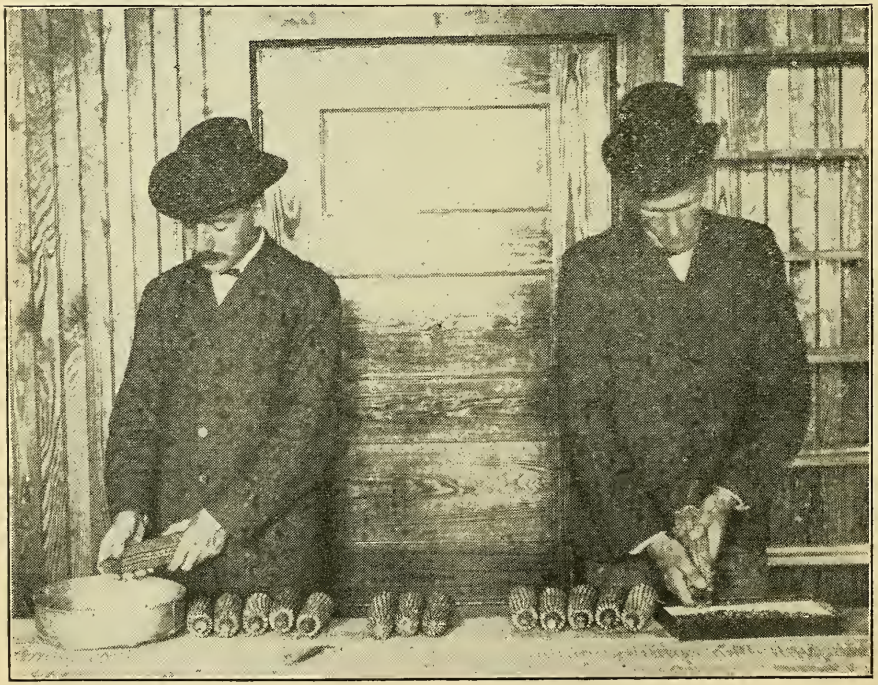

PLATE 10—Shelling the Butt and Tip Kernels

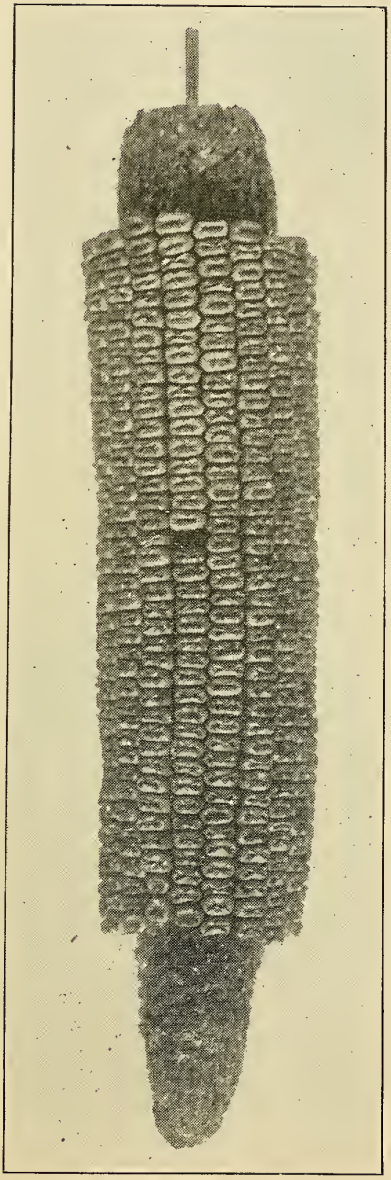

PLATE 11.—Only the Uniform Kernels Remain on the Cob. These Will be Shelled for the Planter Box

their formation and if excluded in the beginning will not bother at any other part of the operation. It is often argued that if we remove the butt and tip kernels we are apt to breed corn that does not have properly filled butts and tips, but this has been proven by all experiment station work in the country to be a fallacy. The butt and tip kernels are not to be shelled off because they would not yield as well as the middle kernels, for work done at several of the experiment stations of the United States has shown that as far as yielding power is concerned the butt and tip kernels have just as much as the middle kernels. This is contrary to some common notions, but it is now known to be a fact. The advantage, then, in shelling the butts and tips lies in keeping the grains of uniform type; and we find those grains on the central part of each ear.

Professor T. F. Hunt in writing on this subject says: "The Iowa Station found that when all the grains of an ear were used in the corn planter the number of grains dropped at one time varied from one to six grains, the planter dropping three grains to the hill sixty-six times out of a hundred. When only the middle grains of the ear were used, the planter dropped two grains eight times and three grains ninety-two times to each hundred hills. Since uniformity of stand is essential to maximum yield, it is therefore good practice to discard the largest of the butt and the smallest of the tip grains. It is also found that in order to secure uniformity of stand it is essential to select ears having grains of uniform size. It was found when long and short grains were mixed together, the planter dropped three grains seventy-five times out of one hundred; while when planted separately with proper plates for each, the planter dropped three short grains ninety-five times out of one hundred and three long grains ninety-two times out of one hundred."

This brings up other questions regarding the preparation of the seed after it has been tested before it is ready for the planter box. After the ears have been butted and tipped each ear should be shelled separately and the kernels from that ear placed in a box which will perhaps be the one labeled "Large." There should be at least two other boxes labeled respectively "Medium" and "Small," and in these will go kernels which fit the directions. In

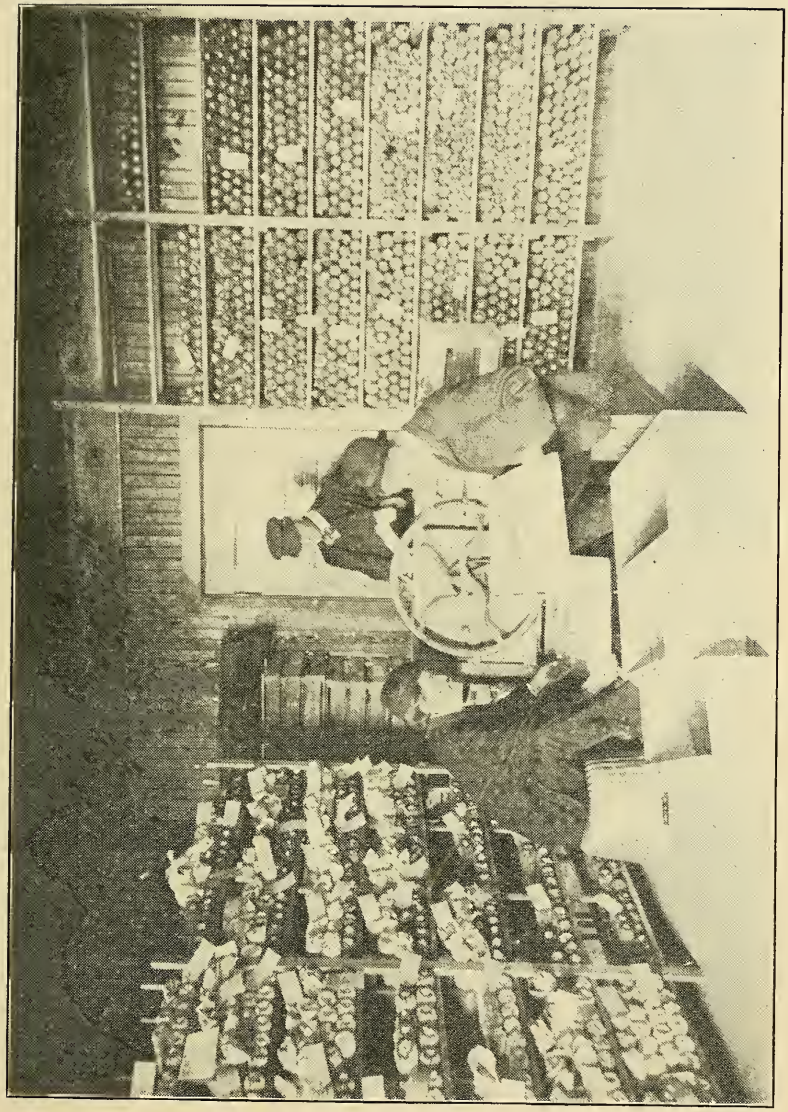

Plate 12—Shelling and Grading Seed Corn

other words, the first step in the grading of the corn is taken. Then, as soon as this is done, perhaps a small hand grader will be convenient for use and this will separate any of the small and poorly developed grains that happen to be in the shelled samples. After the hand grader is used and these irregular kernels removed in this way, if greater care is to be given the plot than perhaps any farmer will give his seed, the kernels will be hand picked and any that show special defects will be removed. Then the final work is done as far as the seed is concerned, unless there be a little tramping of the shelled grain which operation it is claimed will remove some of the chaff from the kernels so that there will be no chance for obstructing the planter when the kernels are put in the planter box.

Adjusting the Planter.

Then comes the work of arranging the planter to fit the seed that has been selected. That can be easily done by raising the planter on some home-made jack of some kind, putting some of the small seed in the planter box and finding the plate which suits that seed so that it will drop three (or whatever number of kernels are desired), to the hill. After the plate for the small kernels is found, the same work may be done with the medium sized kernels and then with the large size, until the three types of kernels have planter plates which fit their size and shape. Then, when this seed goes into the field, notwithstanding its varied size, the man who is doing the work can feel assured that each hill has the number of kernels in it which he desires.

This work done, the corn is ready to be put into the field; or in other words, is ready for the seed bed which the farmer has long before this planned and perhaps made ready. A study of the seed bed, of course, means a study of the soil.

THE SOIL.

What Is It?

There is nothing which we have more to consider on the farm than the soil. And yet, there is no subject which is neglected as

much by those who are dealing with it every day as the soil. Working with it all of the day, walking over it to and from our work, we are apt to take it for granted that the soil is a matter of our inheritance and that we owe nothing to it directly or indirectly. But during the last few years there have been so many things developed concerning the soil and the use to which it may be put that the attitude of those who are really after information has changed until at the present time there is no study which is receiving the attention of more men in all walks of life than the soil provided they have any interest at all in the work of agriculture.

No matter from what part of the earth we take our samples of soil, we find that they are composed of many pieces of various kinds of matter. As a usual thing, the soil is composed of small fragments of rock of many varieties. Or in other words, the soil is made up of fine particles of inorganic matter. Then of course associated, and directly in contact, with these fine rock particles there is, under ordinary conditions, a varying amount of organic matter, which, of course, comes from the breaking down of the vegetable and animal bodies. It then becomes plain that the soil, which is so common to us, is really very complex and is made up of broken down rock materials interspersed with various forms of organic matter which make soils so valuable to the farming world.

There are two kinds of soil that we ordinarly consider along this same line; the one is the surface soil, and the other is the subsoil. The first six to twelve inches of these fine rock particles which have gone to produce our soils we usually consider the surface soil. Just below this, there is usually a sharp distinction of soils and this lower soil we call subsoil. There is generally a sharp line of demarkation, especially in the matter of color, between the surface soil and the subsoil. The subsoil is the part which is unproductive and which remains so until its texture is changed to some extent.

In this complex soil, we find many forms of living matter which show that our soils, as King would say it, are "scenes of life and energy". He says in his small book on the soil, along this line, that "In the agricultural science it should be observed that the most important use of the soil is to act as a storehouse for

water for the use of the plants; and that the productiveness of any soil is determined in a very large degree by the amount of water it can hold, by the manner in which the water is held, and by the facilities and completeness with which the plant growing in it is able to withdraw that water for its use as it is needed." In other words, if we were to take from the soil the water which it contains it would be impossible to grow the plants because there would be no means of transporting the food materials so necessary in plant growth. "But while this statement is true in the fullest sense, it must not for a moment be thought that the composition of the soil is not an important factor in fixing land values for crop production. The importance of the water holding power grows out of the fact that without an adequate supply of water neither the other food constituents which the soil contains nor that large part which is diverted from the air can be procured by the plant nor transformed or assimilated by it. Then again the soil is a wonderful laboratory in which the large variety of the earlier microscopic forms of life are at work during those portions of the year when its temperature is above freezing, breaking down dead organic matter and converting it into those forms into which it becomes available for plant food. And the farmer should never forget that the crop of these invisible organisms which are produced each year in his soil determines in no small degree the magnitude of the harvest he removes from the ground and the fitness of that ground for the succeeding crop. Finally the soil is a means for transforming sunshine and putting it into a form available for carrying on the kinds of work which are there accomplished; and the manner in which the soil is tilled and the way it is fertilized have much to do with the quantity of altered sunshine which becomes available in carrying on the work."

Hunt says in speaking of the soil and its relation to corn production that "The yield of maize is greatly influenced by the character of the soil, perhaps even more so than any other cereal. Alluvial river bottom soil and tile drained swamps furnish the best conditions. A large proportion of the maize crop is grown on drift soil, but not all portions of the glaciated land are equally well adapted to this crop. In the Southern States the red or chocolate-colored upland soils with red clay subsoils are better for maize than

the gray soils with yellow clay subsoils. For its best growth, maize requires a friable soil that is easily drained and does not bake during drouth. While the water should drain freely from the the surface, a water table within three feet of the surface is not objectionable and probably desirable. The free movement of water through the soil in all directions, especially during the period of fastest growth, is essential to the largest yields."

ROTATIONS.

In taking care of these soils that are well adapted to corn, and in maintaining their fertility and physical condition, it is necessary to handle them with what we call a rotation of crops. A rotation of crops might be defined as the systematic use of the land with farm crops. It is true that in many sections there seems to be a tendency on the part of the farmer to overlook the fact that it is necessary, in all the highest types of agriculture, to use a regular cropping system. And as a result, we find a good many farms, in such sections, which are in a run down condition. Such farms may be found in any state in the union, but we find them especially in those states where the fertility of the soil was once at a very high standpoint. Because of improper handling of the soil and the improper use of manures, or the use of none at all, these lands have become practically worthless from the agricultural standpoint, and many of them are selling for practically nothing. Some of the newer states where agriculture is but a matter of a few years back are just beginning to show the effects of improper growing of crops.

Reasons for Rotations.

As Ferguson and Lewis say in their "Elementary Principles of Agriculture", "The amount of mineral food which a crop will take from the soil varies with the kind of crop, depending upon how much of the crop is removed by the yearly harvest, the richness of the land, and many seasonal influences. By refering to chemical tables it wll be seen that the amount of nitrogen removed by grain crops is less than the amount removed by crops grown for

their roots. It will be noticed also that grain crops remove or require large amounts of phosphorus; root crops, potash; and hay crops, much nitrogen, an exception being made for legumes as alfalfa, clover, cow peas when grown for hay crops. Some legume crop should be included in any system of rotation."

It will be seen from this that if we would grow any certain kind of crop for an indefinite period or without change of land, we would be drawing upon a large supply of one of the plant foods which are apt to be lacking in the soil. To make this a little clearer, we find from our study of the soil that there are three elements, namely potash, phosphorus, and nitrogen, which all plants need and which are apt to be lacking in some soils. Now, if some grain crop is to be raised on the land which draws for example heavily upon phosphorus, and this is followed the next year by another grain crop which draws heavily upon the phosphorus, and this is followed year in and year out, the phosphorus will soon turn up lacking in the soil. But if some crop is put on the land which draws perhaps heavily on nitrogen, as the hay crops do, the fertility of the land will be held more nearly uniform. In other words, we do not rob the land completely of any one element; for if we were to leave all of the nitrogen and potash in the soil and have the phosphorus removed, we would still be unable to grow crops successfully.

In continuing the article of rotation of crops which was quoted above, the authors say, "It is desirable to arrange the rotation so that the same land does not have the same crop twice in succession. In arranging the crop, it is important to consider the order in which the crops should follow each other. Plants with shallow roots should follow plants with deep feeding roots. Non-cultivated crops, like grains, should follow cultivated crops, because the land will be better in tilth. As regards the predominating mineral foods, it is better to let those crops requiring a large amount of nitrogen follow potash liking crops, or still better legumes because they will leave additional amounts of nitrogen in the soil which will be very beneficial to the grain, but not so necessary to the others.....Except in arid regions, it is best to keep the land constantly occupied by some crop. That not only keeps the land continually earning something, but it is best for the land.

PLATE 13—Clover Roots, Showing Where the Roots Feed. Clover is Much Different From Corn

A field that is bare or fallow loses more by washing and leeching than land occupied by plants. It is often possible to grow a quick maturing crop after the principal crops have been harvested; for example, June corn after potatoes or small grain, cow peas after corn.

"In planning a rotation or selecting a cover crop, it is neses-sary to consider what may be successfully sold or used to advantage. This will depend upon the markets and the farmer's facilities for keeping and feeding certain kinds of crops."

In summing up, it can be said that when the farmer is selecting crops to fit into a rotation, the crops to be used will be selected depending upon the following things: first, upon what food the plant lives chiefly; second, at what depth the plant grows in the soil; third, at what season in the year a crop is needed; fourth, whether the crop is intended to be used upon the farm or marketed; fifth, the character of the soil and climate; sixth, the disposition of the farmer in doing the work. This last point is one upon which a great deal depends. The fact that in our corn belt states we have corn following oats and oats following corn continually year in and year out has been due to the disposition of the farmer rather than to the needs of his farm, or of the state. It is likewise recognized that a rotation is not a rotation in the strictest sense of the word unless there is a legume in it. And so we find the soils of a good many of our so-called high class farms in rather a poor condition because of the fact that the crops have not been carefully selected.

Now, the question naturally arises, "What would be the benefits to be derived from following an up-to-date method of rotation?"

Benefits of Rotation.

First, the fertility of the soil is maintained. By this we mean that the soil is not depleted rapidly in any one direction. Of course all plants acting upon the soil and drawing upon plant food are taking plant food from the soil and reducing the fertility, but a rotation reduces that fertility uniformly if there is any advantage in that.

Second, the physical condition of the soil is improved. By this we mean the "workability" of the soil. Since the crops in the rotation work at different depths, and the roots are of different shapes we find the soil to be more friable than if one crop is constantly grown upon the land so that there is no special cultivation other than the plowing.

Third, farm labor is distributed over various seasons of the year. Not all of the crops will need be taken care of at the same time of the year as would be the case if the entire crop, for example, were wheat. This means a great deal from the farm management standpoint.

Fourth, much better distribution of the crops is provided, partly because the labor has been distributed through the season.

Fifth, the manuring of the land is facilitated. For example, we know that it is a bad practice to apply much manure directly to small grains, but bring in a meadow or some other form of crop to which a fertilizer may be applied and we can maintain the fertility of the soil without injuring the crops.

Sixth, the land will be rid of bothersome weeds. This is very often done by the cultivated crop in the rotation and it should be understood that every rotation should have a cultivated crop in it as well as a legume; whereas, if wheat or some other crop were to be raised continually on the land, it would mean a continual production of weeds that would take the entire land or such an extent of it that returns would be very unprofitable.

Seventh, insects and fungous diseases are exterminated. Annually there is a great loss in the United States in all crops from these two sources. Insects and fungous diseases have a tendency to live over from year to year on the same crop. Rotation of crops, or the changing of the land in its cropping system, prevents any such conditon as this and as a result checks very materially any progress which these pests have made.

What is a Good Rotation?

There are so many things, as the student will by this time notice, which must be taken into consideration, if a rotation is to

be of any merit, that the beginner in such work may be confused. It would be too much of a task to attempt at this time to give rotations that would suit all localities in the country, but a simple one which is common in a section of the corn belt will illustrate the methods at hand, and if the student wishes to go farther, he can write to his experiment station and get rotations which will fit his conditions. The rotation which is so common in the corn belt is simply corn, oats, and clover. We find several things in this rotation which are to be commended. In the first place, it is short, only three years in length. In the second place, it contains a cultivated crop, in the corn crop. In the next place, it contains a legume, in the form of clover. Now, if ordinary barnyard manure is applied once during this rotation, on the average corn belt soils there should be no reason for the depletion of the fertility. This, of course, holds true only for those lands where the farm practices begin with the virgin fertility. It might be well for the student at this time to ascertain what rotations are best for his conditions of farming.

THE SEED IN ITS HOME.

After the seed has been prepared as the student has already read, and the soil is put in prime condition, it is necessary to take up the matter of preparing the immediate seed bed for the corn crop which, as we are understanding at this time, is the cultivated crop of the rotation.

It is necessary to consider the points, in the first place, which are required for the germination of a kernel of corn. If we determine that accuratly, we will be able to tell why we follow certain practices with our corn crop. The conditions of germination are: first, vitality; second, moisture; third, proper temperature; and fourth, oxygen. If any one of these four factors are absent, the seed will either germinate very poorly, or not at all. The fact that the exclusion of oxygen is almost an impossible matter accounts for the fact that corn will sometimes germinate when it is under water. The important part which we will note later, and which has already been spoken of, is that, if moisture is excluded from stored seeds, germination is prevented.

Vitality.

There is just one part of the kernel of corn which is living, and that is the germ. If the germ is kept alive, the seed will grow. But the first important factor is to have the ability, within the seed, to germinate if we expect to get any growth at all.

The question naturally arises here, perhaps, as to how long corn may be held under proper storage and still retain its vitality. Experiments have shown in several instances that corn which has been kept for six or eight years under proper conditions will still grow with a high percentage of germination. But as a rule, three or four years' old corn has passed its prime stage.

Moisture.

Moisture is necessary for germination because in the process of germination this is the first thing that takes place; namely, the seed swells because of the water which enters it. Omit this step and nothing else follows. In other words, we might say that the entrance of water into the kernel of corn awakens the dormant life within the germ and starts the small plant on its existence. It permits the root to break through the outside hull and to commence growing into the ground; and the plumule to break through the hull and begin going up towards the light.

Proper Temperature.

But it must be remembered that even though we have water present and the temperature is not correct, the water will not enter the seed and plumule and radicle will not be awakened from their sleep. Many tests have been made to ascertain at what temperature the seed will germinate. The highest temperature at which seed will germinate is called the maximum. The minimum temperature is the lowest at which the seed will germinate; and to induce the best temperature, the word "optimum" is used. With corn, it is found that the minimum temperature for germination is forty degrees; the maximum temperature is 115 degrees;

and the optimum temperature is ninety-three degrees. Of course, in the process of germination there is a little heat given off from the seed itself, but surrounded by so much soil of a cooler temperature, the kernel naturally loses this heat rapidly. It is for this reason that we desire a fairly warm soil in the spring before we plant our corn.

Oxygen.

This is the least important item because it is the one which is the most easily supplied. However, the amount which is found in the seed itself is not sufficient to allow it to germinate well and so it is necessary to have the soil loose so that the air can get to the seed at the time when it is needed. One writer suggests that, "The unhealthy appearance of corn on poorly drained soil is usually considered to be due to too much water when it is really the lack of oxygen. When corn which has been planted very deeply is slow in germinating in the spring, especially when continual rains come on, it is due largely to a reduction of temperature and the exclusion of oxygen."

Time Required for Germination.

As will be remembered from the work with the germination box, the time required for germination is about six or eight days. If the ordinary germination box is left for ten days, results will be even better; but as the corn goes into the ground, in the spring, under the weather conditions, ten days to two weeks will be required for the germination of the seed.

PLOWING.

Time To Plow.

It will be necessary to keep the above conditions in mind in all of the work that is done on the soil. The aim should be to supply the factors necessary for good germination and good growth so that the seed and the plant will not be required to live

under unfavorable conditions. The time to plow, of course, will be regulated a great deal by the crops that have been grown upon the land previously. The field which will be selected for corn will be one where some legume has been growing the year before, or, at least, that ought to be true. In other words, the field will be a part of a regular rotation. While it is true every year that corn is produced successfully on sod land, the farmer must not take for granted the idea that that soil is especially adapted for corn. By sod land we mean the native sod. As a result of this assumption, corn is very often put on the same land twice. That is, the second year's crop is on the second year after sod and a conspicuous failure usually results. Corn can not be recommended on other than well worked land, and, of course, the best crop to precede it is the legume. The legume (clover, alfalfa, etc.) leaves the soil in a loose, mellow condition and if some of it is turned under a splendid supply of available nitrogen is made ready. If this is turned under early in the fall, the action of the winter weather on the soil will make available large amounts of plant, food and the time between the fall plowing and the spring planting will afford a sufficient period for the legume to decay.

Now, it is recognized that under some conditions fall plowing can not be recommended; but where corn is raised to any extent the most sucessful results are secured in this way. As Farmers' Bulletin No. 414 says, "Fall plowing can not be recommended on all soils and localities, but should be more generally practiced than at present. If a cover crop or sod is turned under in the autumn, decomposition will increase the amount of plant food available for the crop next summer. This is true to some extent even though the sod is not turned under, inasmuch as the simple loosening of the soil admits atmospheric oxygen and increases chemical action on vegetable and mineral matter. Fall and winter plowing is one of the best methods of combating grub worms, cut worms, and corn root worms which are often destructive to corn. Because the surface of ground plowed in the fall is drier at planting time, in the spring, than that ground not so treated, it does not necessarily follow that there is less moisture in the fall plowed ground. The fall plowing has enabled the rain fall better to penetrate the subsoil, thus relieving the surface of its excess of moisture. In the

spring, fall plowed fields usually contain much more moisture, but at the same time have a drier surface than fields which remain unplowed until spring.

"In sections where there is much rain during the winter, it is better not to harrow the fall plowed land in the autumn. This is especially true of fine clay soils that run together and pack readily.

"In comparative tests of fall and spring plowing preceding a dry summer, the fall plowed fields have generally yielded better. The same is true of subsoiling.

"Deep spring plowing and spring subsoiling are likely to result in diminished crops, especially if done after the spring rains. The loosening of the soil to greater depths admits air and facilitates the evaporation of soil moisture. It also interrupts the capillarity so that moisture is not as readily drawn from the greater depths and during a dry summer there is not enough available moisture to support a good crop." There is very little if any objection to fall plowing where the system of farming or rotations is correct. Too often, when objections come, they arise with those men who are farming carelessly or who have no respect for the fertility of the soil.

The Depth of Plowing.

Here is one point where a great many errors are made. The farmer attempts to save time and labor by plowing in a shallow, slip-shod manner. It is true that if the plowing is done at a shallow depth, there is not the draft on the horses that there would be otherwise. Of course it is known that the best depth to plow for corn will vary with the soil, the climate, the season, and with the general practices on the farm. But as rule, after all the common methods are followed, it seems plain that a depth of about six inches is the best for the most of our corn soils. In plowing, it is always well, however, to remember that the land really ought not to be plowed at the same depth each year since it is advisable to have the soil mixed well. It often seems advisable to plow just a little deeper each year in order to bring up some of the

elements from the subsoil to the surface that these elements may become available for plant growth. Of course it is needless to say that the plow should be adjusted so that it will turn all of the soil and leave all of the surface smooth.

If spring plowing is followed, the disc and the harrow ought to be thrown on the land as soon as the plowing is done. With fall plowing, however, the weather breaks the particles and makes the soil easily worked.

Comparing corn with the other cereals, it is easily recognized that a greater depth is required in the plowing than would be true with oats, wheat, barley, or rye.

After Plowing.

After the land is plowed and the soil is ready to be worked, the disc will be one of the most useful implements that the farmer will use. As has been said, it will not be necessary to disc the fall plowed ground until spring; but as soon as spring opens and a team can go upon the field, the disc ought to be used and the seed bed ought to be prepared carefully. If spring plowing has been practiced, it is just as essential, if not more so, that the cultivation be thorough. Some one has said that the plowing and preparation of the seed bed is one half of the crop; and if we consider that the seed and plant could do nothing without a properly prepared seed bed, we can believe that statement easily.

PLANTING.

The Depth to Plant.

There is always a great deal of discussion on this point. If we take for granted that the field has been prepared in the very best way, using the disc, the drag, the roller, and the spike tooth harrow, the depth of planting comes in as an important consideration and one which the experiment stations of the United States have attempted to decide for a good many years. Some work done at Ohio State University would indicate something of the difference between deep and shallow planting. An experiment

performed at that place showed that planting one inch deep yielded 57.9 bushels; two inches deep, 51.2 bushels; three inches deep, 46.8 bushels. Several seasons favored the shallow planting. Working upon the black soils of Illinois, some experiments performed by the Illinois Station point toward the same fact. Their results were as follows: one inch deep, 78 bushels; two inches deep, 72 bushels; three inches deep, 65 bushels; four inches deep, 69 bushels; five inches deep, 61 bushels; six inches deep, 60 bushels. Work done at other stations seems to indicate that the shallow planting has the advantage over the deep planting. It is thought that the reason for this reduced yield is not the fact that the corn does not produce vigorous ears, but to the fact that the stand is reduced because of the depth to which the kernels are placed. If, however, it is planned to do any cultivating in the field after the corn is planted and before it is up, it will be necessary to put the seed perhaps a little deeper than would otherwise be the case. A false notion seems to prevail in a good many sections to the effect that the deeper we put the seed the deeper the roots will be. But this notion is easily proven wrong by field work; for the depth of the roots is not materially affected by the depth to which the seed is placed in the soil.

Hills or Drills.

There are very few men nowadays who plant their corn by hand. It is true there are some in the more intensive districts, but their methods give one more chance for a loss financially. It would be far better if they would practice some of the more extensive plans. But where machinery is used to a great extent, the ordinary planter offers two ways of putting the crop into the ground. The first by drilling, the second by check-rowing. Drilling, of course, means putting the seed in the ground at short intervals in the row, while check-rowing places the corn into the ground at regular intervals. The question always arises, at an institute where the subject before the meeting is corn, whether hills or drills produce the greater yield. Experiment after experiment has been carried on along this line, all with the same result;

namely, that there seems to be no difference in favor of either method. The fact that the check-rowing allows the ground to be cultivated in two directions is a very large point in favor of that method. This of course, considers the crop as raised for the ear itself. If raised for the fodder, it may be advisable to plant the seed more closely together in order to bring about a finer structure in the fodder itself.

Listing.

In some sections where there is not a great deal of rainfall it is found best to plant the corn by listing. By listing we mean planting the corn in a furrow.

As a usual thing, it is drilled in; but whether it is drilled or planted in hills the plow precedes the planter part proper, making a furrow into which the kernels may be dropped. This places the kernels down to a depth where the moisture is, perhaps, more in abundance. As the grains germinate, they come up to the surface of the bottom part of the furrow and to cultivate the field an implement which will prevent the covering of the plants, and yet which will stir the soil, is used. There are various devices to accomplish this object. One of them inverts a trough over the ridge and, of course, when the soil is stirred it falls down on the sides of the trough rather than on the corn itself, and yet the ground is stirred and the weeds covered. Those men who are definitely interested in this type of cultivation claim that the weeds may be freed from the land with much more ease than if corn plants are surface set. The fact that the weeds are much more easily eradicated in this way may also be partly due to the fact that there is less moisture where the practice of listing is in vogue.

Time of Planting.

The time of planting will vary with the kind of corn that is used, the variety that is planted, the climate conditions under which it is to be grown, the soil, the implements used, how well the seed bed is prepared, and perhaps other conditions which are local. But as a general rule in the sections of the corn belt itself, the corn is put into the ground about the tenth of May. It should be remembered that if the seed bed is well prepared and the soil well drained the corn may be put into the ground earlier and get good results. But the advice is generally given, and correctly so, by those who have had a great deal of experience, that corn put in a cold seed bed never does well. So the time of planting will be regulated by the conditions under which the farmer is working rather than by any set date. If he holds in mind the principles required for germination there will be no mistake on his part.

The Rate of Seeding.

Under this subject would really come the distance between hills or the distance between stalks in drilling and a great deal has been done along this line by almost every experiment station in the United States. Work which has been done at these stations in general, is correct for the farms of the state in which the work was done. But it has been found that the work of the experiment stations is not always reliable for all parts of the state; so where funds have been made available in the last few years, the various stations have been establishing sub-stations over the territory which they control. In this way the various conditions in the different localities are studied in a definite way.

The number of stalks to the hill comes in under this subject also. The ordinary distance between hills is about three and one-half feet each way. The number of stalks per hill in most of the corn growing sections is considered as three. That is the best results can be obtained if three stalks are in each hill. But just recently experiments with some of the smaller varieties of corn

lead us to believe that four stalks, and even five, are desirable under these conditions where the hills are three and one-half feet apart. This may be due to the fact that the smaller plants and the smaller grain produced draws less heavily upon the soil fertility than do the ranker growing varieties of some of the southern corn growing sections. If corn is planted the ordinary distance apart and only one stock is grown in a hill and every stock produced an ear weighing one pound, the yield of an acre would be more than forty-five bushels. That would make two stalks in the hill produce ninety bushels, and three stalks, 135 bushels per acre.

This brings up a large question, that of whether barren stalks in the field are desirable or not. For it must be realized that, if 135 bushels could be raised to the acre with a perfect stand and each stalk producing a well developed ear, our present yield indicates that we are not producing stalks and ears as theory would say we ought to do. So there must be some barren stalks in the field We mean by barren stalks those which do not produce an ear worth harvesting and there will be places where the seed has not germinated well, even with all our care in producing a good stand. But if we can come as near to the ideal as possible, we will get our maximum yields, and for the most of our corn belt soils the attempt should be to get three stalks to the hill about three and one-half feet each way. Or if drilling is practiced, the stalks should be twelve to fourteen inches apart.

Weeds.

How to control weeds is one of the problems of the farmer. We usually include under the term weeds any plants, which grow on the soil, and which are not desired. There are so many that grow in corn fields that an attempt to list them in this place would be entirely out of order. The most of them can be controlled by ordinary cultivation, but many times it takes special care other than ordinary cultivation, as with the quack grass or Canada Thistle. Weeds have a bad effect upon the land. Some weeds give off

substances which are to a slight extent poisonous to the soil, but this evil effect is by no means commensurate with the fact that the weeds take plant food and moisture from the soil when the corn plants ought to be having it.

MANURES.

The great problem of how to use manures is confronting many farmers in many sections of the United States, and broadcast advice can only be given in a general and vague way, for so many of the conditions which affect one locality do not affect another. There is one feature, however, which will apply to the soils and that is that barnyard manure is good for the land. Many of the old English writers on agriculture after long discussions upon commercial fertilizers came down to this plain statement: Barn yard manure furnishes the elements which are necessary for plant growth to some extent and at the same time furnishes organic matter for the soil which will improve the physical condition to a very great extent. Many of the commercial fertilizers, while supplying the plant foods, do not add any organic matter to the soil; and as a result we have what is known as "baking" of the soil. The evil results coming from the use of manures are not due to the fertilizer which was used but to the manner in which it was applied to the soil. It must be remembered that the plant is to be fed just the same as the animal if the plant is to live and do well.

In speaking along this line of feeding the plant, "The Book of Corn" published by the Orange Judd Company says: "Large quantities of fertilizer are not recommended for corn under average conditions. An application of a medium amount will be more likely to result in a profit. Where farm manure is not available and entire dependence is placed upon purchased supplies or where raw ground instead of sod is used, mixtures containing large proportions of nitrogen and heavier applications are required. A brand containing nitrogen four per cent, phosphoric acid (available) eight per cent, and potash eight per cent, applied at the rate of

500 pounds per acre will supply the needed constituents in good forms and proportions. Part of this application may be made broadcast and harrowed in; the remainder, say one-half, applied in the drill at the time of planting. It is a good plan to apply the materials broadcast wherever possible; and in lieu of the recommendations made, 350 pounds per acre of mixture No. 1 may be used applied broadcast in connection with a compost applied in the hill. (Mixture No. 1:—Ground Bone, 250 pounds; Acid Phosphate, 500 pounds; Muriate of Potash, 250 pounds.) This would be particularly advantageous in heavy clay soils as it is desirable, there, to have manures well distributed and to encourage the early growth of the corn by substances high in organic matter applied in the hill. This compost may be made up largely of fine cow or horse manure, fortified by the addition of ground fish, dried bone or cotton seed meal. The addition of 300 pounds of dried bone or 500 pounds of ground fish or cotton seed meal to a ton of dry composted manure would be excellent for this purpose and make a relatively cheap compost. In the southern states there is probably no better and cheaper, and therefore no more satisfactory form of organic nitrogen, all things considered, than cotton seed meal. And in Georgia particularly where a careful study of the matter has been made, the following formula has been recommended for well improved upland soil or bottom lands:—Cotton Seed meal, 870 pounds; Acid Phosphate, 1000 pounds; Muriate of Potash, 30 pounds; or for wornout upland soils:—Cotton Seed meal, 1000 pounds; Acid Phosphate, 1250 pounds; Muriate of Potash, 30 pounds. The chief need of these soils is more nitrogen and phosphoric acid. An application of 250 to 400 pounds per acre has been found to be the most economical. This recommendation will probably apply to the uplands and bottom lands of the Southern Coast States; whereas for the sandy lands, a large proportion of potash is needed. In Kentucky and Tennessee, potash has been shown to be a very important ingredient in fertilizers for corn."

It will be noticed that the writers of this paragraph lay a great deal of emphasis on nitrogen and phosphoric acid. There is no reason for buying nitrogen when the air contains so much and the legumes have the ability to take that nitrogen and place it in the soil for use. If the phosphoric acid can be obtained in the form of

ground raw rock, it will be much better for the soil and will last much longer than the strict acid phosphate itself.

CULTIVATION.

The cultivation of corn determines whether the corn yields well or not. Of course it is not the only determining fact, but if the corn received improper cultivation a loss in the yield always results. The use of cultivation is usually stated in three divisions: first, to conserve the moisture in the soil; second, to aerate the soil; third, to kill the weeds.

Under average conditions in the most of our corn producing states the conservation of the soil moisture is the most important work which the cultivation accomplishes. The way in which this moisture is conserved may be illustrated by a very simple experiment. Take some colored solution like red ink or black ink, an ordinary lump of sugar, and some powdered sugar. Be sure to use the powdered sugar in this work as some of the other kinds do not illustrate the point. If the colored solution is allowed to strike the bottom part of the loaf sugar it will immediately rise to the top. If there is a layer of the powdered sugar over the top of this loaf, or if the powdered sugar is thrown on this loaf at this time, the moisture will go no farther than the powdered sugar line as indicated by the color of the two substances. We might compare this to the plowing and cultivating of the soil. We want in the seed bed a compact bed and a deep one. If it is compact it will allow the moisture to rise as this experiment has shown it to do in the lump of sugar. Cultivating it in the top layer produces a stopping place for the moisture and very little is evaporated from the surface of the soil.

Water plays such an important function in the plant that it is necessary to have a large supply and yet the soil must not be too cold. In other words we want a well aired soil containing plenty of moisture. How to maintain this supply of moisture by a dust mulch is a question for argument even yet. Most soils, however, require shallow cultivation rather than deep. The reason

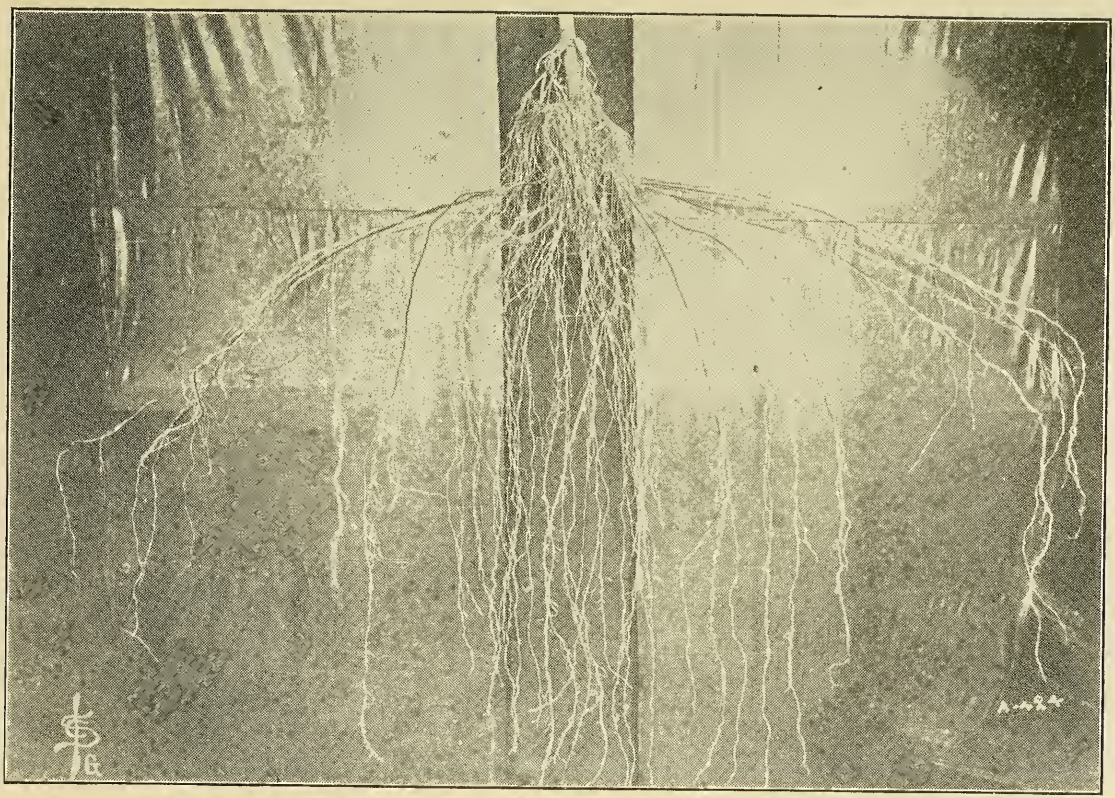

PLATE 14—Corn Roots. Their Means of Growth Will Not Allow Deep Cultivation

for this is explained by the fact that the roots extend so close to the surface that if deep cultivation is practiced they will be injured to such an extent that the plant will be producing a low yield. The Illinois Agricultural Experiment Station has performed a good many experiments along the line of how to cultivate corn to the best advantage and the conclusions which they draw are that shallow cultivation in the long run produces the best results. However, it is nothing exceptional to pass along the road during the laying by of the corn, there to see men hilling up and ridging the corn rows. Of course they must practice deep cultivation to get the deep ridge. There is no advantage in this practice. It only throws the surface of the soil open to more wind and more sun by means of which the moisture may escape. This results, of course, in some loss to the crop.

What Cultivator to Recommend.

Questions come to the Agricultural Experiment Stations time and time again asking what cultivator ought to be used in order to get best results from the corn. In general, it may be said that any cultivator that will not injure the plant above or below the ground and yet one which will keep a dust mulch on the top of the ground is one which is desired. A large shovel cultivator will not do this. But there are many knife cultivators, and small shovel cultivators, which will produce the results desired. It is often found advisable when the corn is very small to run over the field with a weeder. This weeder reaches a great many of the smaller weeds which would not be reached by the cultivator itself later and it does no damage whatever to the growing crop.

THE CLIMATE.

The climate is too often blamed for the work which the farmer has neglected, but it is true that the climate influences the habit

PLATE 15—Laying by the Corn.

of growth of the corn plant. Upon this point, Hunt says, "There is greater variation in the habit of the maize plant than any other cereal. These variations in any one of the five types of maize seem to be correlated with the climatic conditions as indicated by the great variation in size and in the time of maturity in northern as compared with southern latitudes.

"The growing season for maize varies in different sections of the United States from ninety to 160 days and varieties exist which are adapted to these different growing periods. In general it may be said that as we go north or south of a given latitude a variety becomes one day later or earlier for each ten miles of travel, the altitude remaining the same. Care should be taken, therefore, in selecting new varieties, to get them from the same latitude. If obtained from much farther north they may ripen too early and consequently be too small. If obtained much farther south, they may not ripen.

"Size and period of growth are also influenced by moisture. Under conditions of favorable water supply, the plant continued to grow, while a deficiency will reduce growth and hasten ripening."

It is also known that climate will influence the chemical composition to a certain extent and also the physical characteristics of some of the varieties if changed from one place to another. It takes as a rule about eighteen inches of rainfall to produce 100 bushels of corn to the acre. Of course if eighteen inches is all the rainfall that is secured it would be necessary to conserve every ounce of it to produce the maximum yield which the land ought to give.

THE FARMER.

On this point, orators have talked and columns have been written but there are still those men in the farming profession, as

there are in many other professions, who do their work in a slip shod way. Then when the reckoning comes they say that the weather was against them or that they had bad luck or they offer some excuse which does not lay the blame upon their work at all. It ought to be remembered very carefully that unless the man who is doing the work looks toward the details, is careful in everything he undertakes, knows what he is about, and does what he knows—unless the man is of this character, a failure is bound to result from the work that he does.

THE HARVEST.

To the days of harvest, every farmer looks forward. In fact, this is the goal toward which he has been working and if he has been satisfied with his work through the months of culture the yield ought to be high. The time of harvesting is important, especially from the seed standpoint; but from a cribbing standpoint it is important as well. There is just one thing to say along this line and that is that the harvesting should be done as early as possible, which statement might be made in regard to any work of the farm. Of course the grain ought to be well matured before it is cut or before it is picked so that the moisture content will not be so high that the corn spoils when put into storage. The methods of harvesting and the machinery used are all too familiar to those who have lived in the corn sections of the country to be mentioned here.

But even with the difficulties of the harvest time there is no period of the farm life which is brighter. Then comes the storing of the corn which should be cared for in an intelligent manner. Much labor has been put upon the crop, the harvesting has taken time and patience, and now the corn is ready to be turned into meat which will mean increased returns to the farmer. A glance ahead will determine what ought to be done. A little thought occasionally given to the work will mean at the end financial returns which will well pay for all the hard labor that has been put upon the culture of the plant.

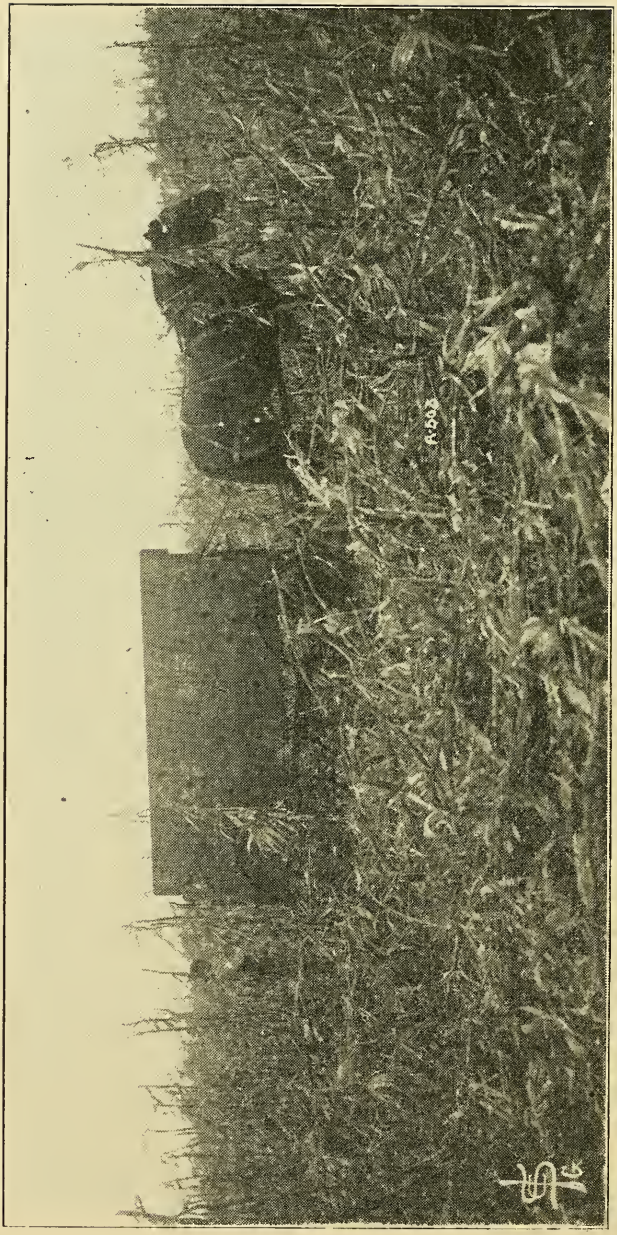

PLATE 16—A Familiar Harvest Scene in the Corn Belt

EXAMINATION

Note to Students—These questions are to be answered independently. Never consult the text after beginning your examination. Use thin white paper about 6 in. x 9 in. for the examination. Number the answers the same as the questions, but never repeat the question. Mail answers promptly when completed.

Questions.

1. What is corn culture?
2. Of what value would the study of Botany be to the farmer?
3. What was the yield of corn in the United States in 1909?
4. Name five possible causes for low yield in corn.
5. Why is the seed so important?
6. Does it matter what varieties of corn a man raises? Why?
7. How can we move varieties of corn and do it successfully from one locality to another?
8. What do we mean by a variety of corn?

9. If seed can not be secured at home what is the best thing to do?

10. What are the possible ways of selecting the corn from the home field?

11. What are the advantages of each?

12. When should seed corn be selected and why?

13. Give the dates set by various states for selecting seed corn.

14. What points should be noted in selecting seed corn from the field?

15. Name three ways that you know seed corn may be stored safely.

16. Why is testing of our seed corn necessary?

17. Describe a way in which corn may be tested satisfactorily.

18. What points ought to be regarded in preparing a germination box?

19. How can we tell good corn as we see it germinating in the box?

20. Why should the butts and tips of the ears be shelled before putting in the seed? Is there any loss in this way?

21. What advantage is there in arranging the planter so that the seeds drop uniformly?

22. What do we mean by the soil?

23. What are the uses to which the soil is put?

24. What is a good corn soil?

25. What do we mean by a rotation?

26. Why is a rotation desirable?

27. Why is it suggested to keep crops on the soil all of the time?

28. Name in detail the conditions of germination.

29. What is the best time to plow the land?

30. On what land should corn be grown?

31. Give some of the advantages of fall plowing.

32. Why is it necessary to plow deeply in most cases?

33. How ought the seed bed to be prepared?

34. What do we mean by drilling the corn? What are its advantages over check-rowing?

35. What is listng?

36. Under what conditions is listing practiced?

37. At what time should corn be planted? Does this vary with the different states, and why?

38. What can be said about the use of barnyard manure in the production of corn?

39. Are commercial fertilizers ever desirable?

40. Name some of the materials which are used in making up a commercial fertilizer for corn land.

41. State four ways in which the climate will affect the growth of the crop either for better or worse.

42. Cite three or four instances where the climate has affected the crop either for better or worse.

43. What characteristics ought a farmer to possess to grow corn successfully?

44. When should the general harvest take place?

45. In what ought all of the general culture of corn result?

Write This at the End of Your Examination

I hereby certify that the above questions were answered entirely by me.

Signed ----------

Address ----------

The Correspondence College of Agriculture

CORN—PART THREE

THE

Correspondence College *of* Agriculture

FORT WAYNE, INDIANA

CORN—Part III

Corn Culture

By HARRY B. POTTER, B. S.
"Farm and Fireside"
Springfield, Ohio

This is the Third of a Series of Four Books giving a Complete Course of Instruction on Corn

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The CORRESPONDENCE COLLEGE OF AGRICULTURE

NOTE TO STUDENTS

In order to derive the utmost possible benefit from this paper, you must thoroughly master the text. While it is not intended that you commit the exact words of the text to memory, still there is nothing contained in the text which is not *absolutely essential* for the intelligent corn grower to know. For your own good never refer to the examination questions until you have finished your study of the text. By following this plan, the examination paper will show what *you* have learned from the text.

JUDGING CORN FOR THE MARKET

INTRODUCTION.

The time has passed when corn is placed on the show table merely to be judged, as the saying goes.

Time was when there were many who would be willing to take corn to a show that it might win a prize. Now interest is even greater than in former times, but the fact that there is greater interest now than ever before is due to the associated fact that there is a different method of procedure. The old system of judging corn on some fancy points is a matter of history. And yet after a careful survey of the entire history of corn judging one must admit that many of the points which were considered so essential in an ear of corn in the days past are just as essential today but the reasons for those points is discovered. That differentiates the old from the new, the past from the present.

But the question naturally arises: Why is it at all necessary to know the reasons for these points of judging? To know the points is sufficient. The answer comes with the more accurate age of which we are a part, and it is that this present day will not stand for a mere statement of what is presumably true, but demands a proof. The attitude thus expressed on every hand, by word and action, has made it necessary to look into the points of the ear of corn previously considered good to see whether the truth was being spoken or not.

The result of these investigations can be given only in part, but that is to be a portion of this lesson. Almost everyone has some ideas

as to the qualifications for a good ear of corn, and so it is not the intention to repeat stock phrases except as they will help bring out the point at hand. As was said many of these phrases must be taken for the truth until such time when experiments will have been conducted long enough to make what is said accurate.

One of the objects of this lesson is to bring out the points old and new which have to do with better corn, so that the student when he has completed the course will be able to judge correctly as to the merits of one class of corn when compared with another.

The Markets Set the Standards.

There is a great deal of difference in the amount of corn fed by the various states in proportion to the total amount raised. It is interesting to note two of the leading states in the production of corn, Illinois and Iowa. These two states have what will always be considered ideal conditions for corn growing. And these ideal conditions count for a great deal. But the use to which these thousands and thousands of bushels of corn are put is not determined by the weather. It would be difficult to ascertain what is the cause of the differences in the disposal of the crops in Iowa and Illinois, but the student of the markets will tell you that Illinois sells the most of her corn on the Chicago and near-by markets while Iowa is feeding her corn. It is altogether possible for the farmer to do as Illinois is doing and yet maintain the fertility of the soil, but the safest policy is to feed on the home farm. When this is done with skill back of the feeding there will be as large returns or larger, financially, and the value of the manure being added to the soil cannot be estimated.

However this may be, there is a present day financial interest that sets the standards for the relative profit that may be made. Let me make this point clear. There may be a market close at hand where a large amount of money may be secured from the sale of the corn direct. We will say that there is a corn-starch factory, or a brewing concern at hand. The demand for good corn is great. Consequently the price that is paid is high. The farmer, in considering whether it will pay him to sell his corn or not, must consider the market price. The fact that there will be ready money resulting from such a deal has its influence, and so if the market speaks loudly

enough the corn is sold and the land goes without the manure. Consequently the market sets the standard for the farmer. And this is true whether the farmer sells his grain on the market or not.

It is the common thought that the feeding use to which corn is put as it is sold from the markets sets the standards for that price. This is true only in a limited way. Of course when a car load of corn is fed to a bunch of steers there is naturally an influence on the market price. But the factors of a more commercial nature have so much prominence that the amount of feeding, great as it is, is hardly perceptible in its influence on the market value.

It would be going into a great deal of detail to take up the various manufacturing concerns that use corn in the ware that they are producing, and which when resold brings per bushel of corn used far more than would beef or pork produced from the same amount of corn. But there are an infinite number of these concerns and they are influencing the markets.

So really, after all argument is made one way or another, the market, we conclude, tells us how much we are to receive for the corn that we have to sell and that market is not based on one use to which corn is put, but is based on many uses, and includes whatever influence feeding has had.

The Farm and Corn Standards.

But there is another phase to the matter which has been left out thus far and which is of much importance. The market speaks of quality, but says nothing as to quantity to be raised per acre.

There are two ways in which the farmer may increase his net income from the corn crop. The one is to grow better corn. The other is to grow more corn. The ideal of every farm should be to grow more and better corn on every acre.

And it is the farm that says "more." Or perhaps it is the farmer as he is trying to get the mortgage paid, or to send the boy off to school. Whatever the reason the fact remains. There is no reason why these two standards cannot be run hand in hand. The past, however, would lead us to believe, if we are to trust history, that either quality or quantity could exist, but not both. That is, there

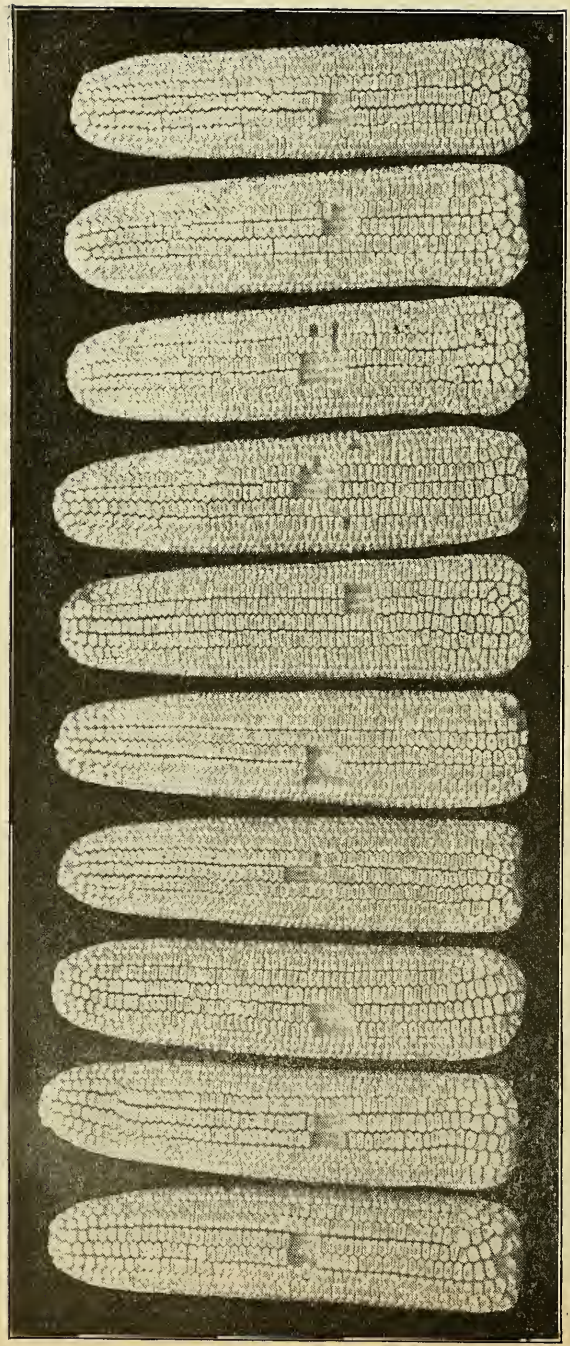

PLATE 1.—A fine sample of corn. In fact it was the best ten ears at the National Show held at Columbus, Ohio, in 1911. The variety is Johnson County White. This same variety has won for several years because of its good breeding along the lines that make high yields.

were advocates of the fancy ear of corn who forgot all about the real practicable ear, while there were those who said that the ear wanted was the large ear regardless of its form.

In some respects both were right. But it remained for the next set of workers to combine the two standards.

Judging Should Conform to These Ideals.

So when corn goes on the show table today it is subject to the test as to quality and as to quantity. At least it should be.

There is reason and sound judgment in this policy. What farmer wants to raise corn that will go on the market in a poor condition or that will mould before he has a chance to feed it? What farmer desires to raise corn that while it may be sound and mature will yield only a part of what his neighbor's corn is yielding?

Of course it will be said that there has always been the hope on the part of everyone interested in the production of corn to get more to the acre. That is true. But there has been a wide separation at the show table because of the fact, as before mentioned, that the fancy points were supposed to bring the best results in the field. The interest of this present day lies in the work which is being done to ascertain what ones, of the numerous points usually conceded to be true, are actually correct.

The Fault of the Past.

If the past work with the show table where corn was being exhibited is to be censured, it is in the fact that those who did the work thought too much of these fancy points. Example after example might be given where prizes were awarded because the samples winning just suited the fancy of the judge. After all is said it is of course true that the judge must place the corn according to his ideas and yet at the same time this ought to mean that his ideas are not such as have little or no truth back of them.

Let us cite an example of this. There was a time when the well filled butt and tip were the first things that judges looked for. That is not true today for the reason that the men who have been work-

ing with corn have discovered that there is no need for so much importance on these two points. How has this been discovered? In the usual way that all agricultural problems are solved: at the experiment stations. There have been a number of stations working with such problems, and all of them have come out with the statement that there should not be a well filled tip if the other points of the ear, such as the kernel shape, and size, are to be sacrificed for it. And yet that is just what the workers of past days were doing. Here is where we are able to profit by the experience of others. No doubt there are mistakes in our own work that the generations following will correct.

The Show and the Judge.

Of course the importance of the judge's work does not show as plainly anywhere as it does in the show ring. As a matter of fact that is the place where it really is of the least importance, for the work that is done there is only preparatory to the greater work to be done at the home farm. There are those men, strange as it may seem, who are able to judge at a show, but who when placed at the farm are utterly useless. The benefit that they are to farm life then is only indirect. The man who learns from the show and takes that knowledge to the farm is the one who places the learning where it belongs.

Important Shows.

Over the country there have been held many shows of some importance. All of them have a bearing upon the agricultural interests of the section where they are held. The National Corn show which has been held at Chicago, Omaha and Columbus during various years is the greatest show of its kind in the country. Thousands of ears of corn are placed on exhibition at this National show. It is usually held during the month of December. Throngs of people from all quarters of the globe attend and thereby show the great interest that is more and more centering in agricultural pursuits everywhere. Other shows such as that held at Council Bluffs, Iowa, under the name of the Missouri Valley Corn Show, and those held

at Lafayette, Indiana; Des Moines, Iowa; Lincoln, Nebraska; Urbana, Illinois, and a dozen or more other places are attracting a great deal of interest. They are all big shows even though there are not the entries found at the National show. They are big because of the purpose behind them.

So, after all, every show held is a big one, even though that show be but for a very small section. Where ever a county takes enough interest in the farming of its district to have a show there is a big work being done. Such a work ought to be taking place in every community.

The Value of Judging.

The statement has already been made that the value of the work which is done around the judging table does not lie in the fact that there are a few samples of corn placed one over the other in order of merit. It lies in the fact that there is someone who will see wherein he is not raising the kind of corn that is best, and the result will show on the farm. It is on the farm, then, that there should be the largest benefit and if the work does not show there it will have been done in vain.

But there are some benefits coming to the man who is doing the judging that ought to be mentioned at this point. In the first place there are some qualifications of a good judge that are necessary for efficient work. These might be summed up by the words, quick, attentive, enthusiastic, keen of eye, and fair minded. Quick because the man who goes too slowly will never be able to accomplish the work that is often placed before the corn judge, and yet this qualification will never include hastiness, for the man who places his ideas too thoughtlessly will make mistakes of all kinds. Attentive, because the very work that he is to do has for its purpose the art of seeing things. Enthusiastic, because he could not do the job well without a deep interest in the purpose of such work. Keen of eye, (which is more a matter of training than it is of ability and yet there are those who possess a large measure of this talent), because of the details incumbent upon the judge of good corn. Fair minded, for the reason that there are so many prejudices to overcome and so many influences that are apt to work for unfairness.

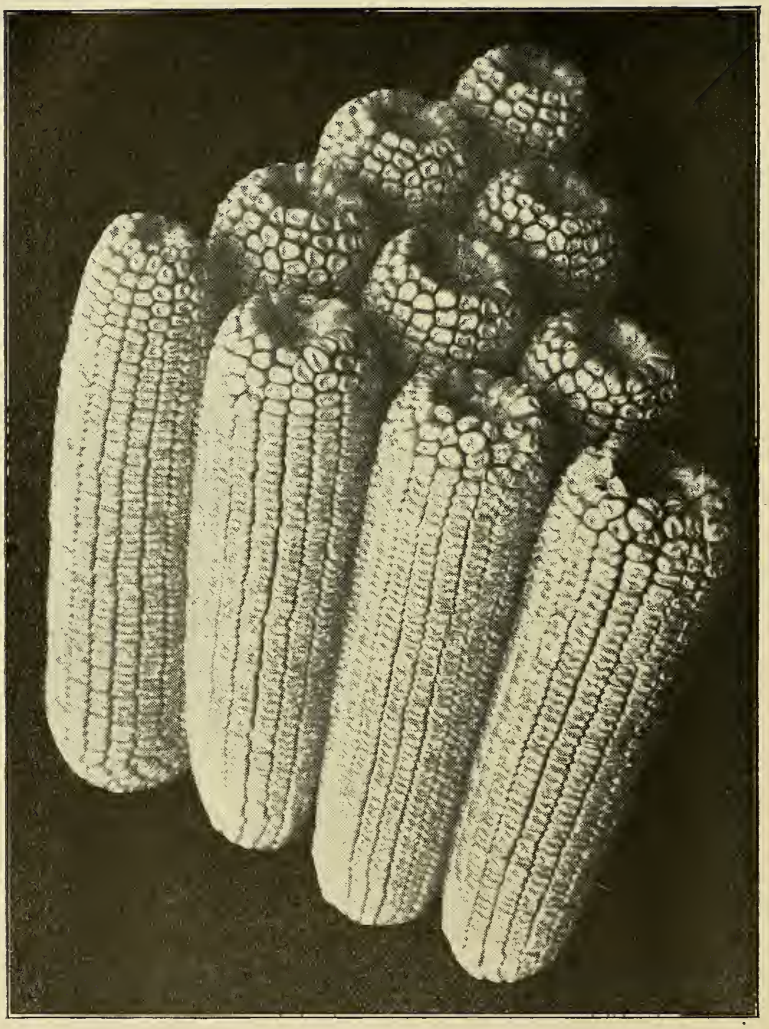

PLATE 2.—In 1907 Johnson County White began to be known. This ten ear sample won the high honors at the National Corn Show at Chicago, and then sold at auction for $550. It paid to raise good corn in this case. The show is but an indication of what will pay on the average farms. Not that this corn is for all farms, but a corn of good breeding is needed everywhere. Why not begin by breeding the corn that you have on the home place?

Then follow the benefits for such work and they are right in the trail of the qualifications mentioned. The eyes are trained for seeing quickly, thoroughly, broadly, and with other things in mind. That is with a view of the other good samples of corn everywhere even though the one at hand does have a few fancy points that particularly please.

Judging and Scoring.

We have gone thus far and have said nothing about the word judging itself. What does it mean? Then there is the other word of scoring that is used so much in connection with corn shows. What does that mean?

Judging is the work which is done when a number of samples or ears are placed in order of their merit, putting the best sample or ear first, second second, and so on, and has nothing to do with figures at all. Scoring is the work done when a sample is taken and a value given on that sample as compared with an ideal which the man, who is doing the work, has in mind. No other sample need necessarily be around. The work of scoring does not have the object in mind of placing samples or ears. It simply gives a value to the ear, the same as a grade may be given to a pupil in the class room, and this practice is subject to the same criticisms and errors with corn as with pupils.

Other Judging Work.

The principle of judging is common in many walks of life and many vocations. All agricultural products go under the eye of the judge, animals, plants and work. Every day the ball games of the land display a feature which really is based on the decisions of one man. Perhaps the greatest American event along the line of agricultural shows is the International Live Stock Show at Chicago. No greater event in its size and importance to the agricultural interests of America could be planned. And this is based on the work of judging, for if that were eliminated there would be no reason for the show. Very few shows have interest where the best specimens are not pointed out to the spectators.

Animal and Plant Judging.

In this connection it is interesting to note the similarity between plant and animal judging. And at the same time the dissimilarity becomes apparent. At the very outset, in the judging of stock, we deal with the living, the animate, while with grain we are dealing with that which no longer has life in a perceptible form. We come in contact with an animal and learn it through its movements or actions. With grain there is no movement on which to place the judgment. Likewise there is a difference in the form. In the animal life we have the object in all of the stages of its development, from the very young creature to that mature. With plants, the most common is the mature product only. But we find many of the same terms used, such as constitution, breed type, and the like. But the main similarity comes in the manner by which the work of each group of objects is accomplished. Of that we will speak later.

THE SCORE CARD.

The Value of the Score Card.

There has been all sorts of controversy over the use of the score card just the same as there has been disputes over the system of grading in the public schools. While we let those men who are specially interested in the educational work fight that matter out yet we are interested because the subject relates to agriculture. The point under dispute is that of whether or not the card will tell what an ear in a sample or alone is really worth. There has been little or no dispute over the matter of the educational benefit to be derived from a use of the score card. Everyone admits that the card is one of the best methods of training students to be efficient judges. The Score Card is not then an end in itself, but it is a means toward an end. That end is a better knowledge of corn.

So we are studying the corn in the ear, plant, and as it is found on the market we must remember that what we are doing is learning corn. We are not committing a card with the figures on it. But in order to bring out the points in the best manner the card will be used here. In all of the work keep an ear of corn on the table or

on your lap or in your hand so that as the various points are mentioned you can see the corn, or perhaps a good picture of some corn, rather than the figures on the card and nothing else.

The Score Cards Used Here.

In the first part of the work the score card, as it has been arranged by Iowa State College, will be used. This card is still used there and with modifications in several other places. Cards will be used later on that will bring other points to your attention.

Before we start in, there ought to be, within easy reach, a full tray of corn. That is, ten ears. Ten ears is the standard number used in all judging work. And these may be laid on the floor with a nail between each two ears, or a strip of wood or a corn stalk may be placed between the ears if the corn is laid on a place where nails may not be driven.

We will suppose that we are going to judge a regular show and that there are a number of samples like the ten-ear sample with which we are working, that all of these are trying to win. What the judge is to do is to place a fair estimate on each sample. Bear in mind that we cannot finally place the samples by the card, but that the card brings out for us the defects and the merits of the samples at hand. We are not yet very far along in the corn judging business.

The corn is to be studied under four heads: 1—Will it yield? 2—Will it ripen? 3—Will it grow? 4—Does it show improvement? These are all difficult to determine, but the last two are the most difficult. These parts will be studied separately. Each part will be allowed twenty-five points for the perfect. By that is meant that if an ear is without fault in the characteristic being studied it will be credited with 25, but if there are some faults, the 25 will be reduced to whatever the seriousness of the faults demand. To illustrate that point: Suppose that an ear to be perfect in shape must be cylindrical, and that 25 is allowed on shape. Ear number one is just a little tapering. Ear number two is very pointed. Ear number one would receive as its value probably 23, while ear number two would get but 14. The whole card when completed will look like this:

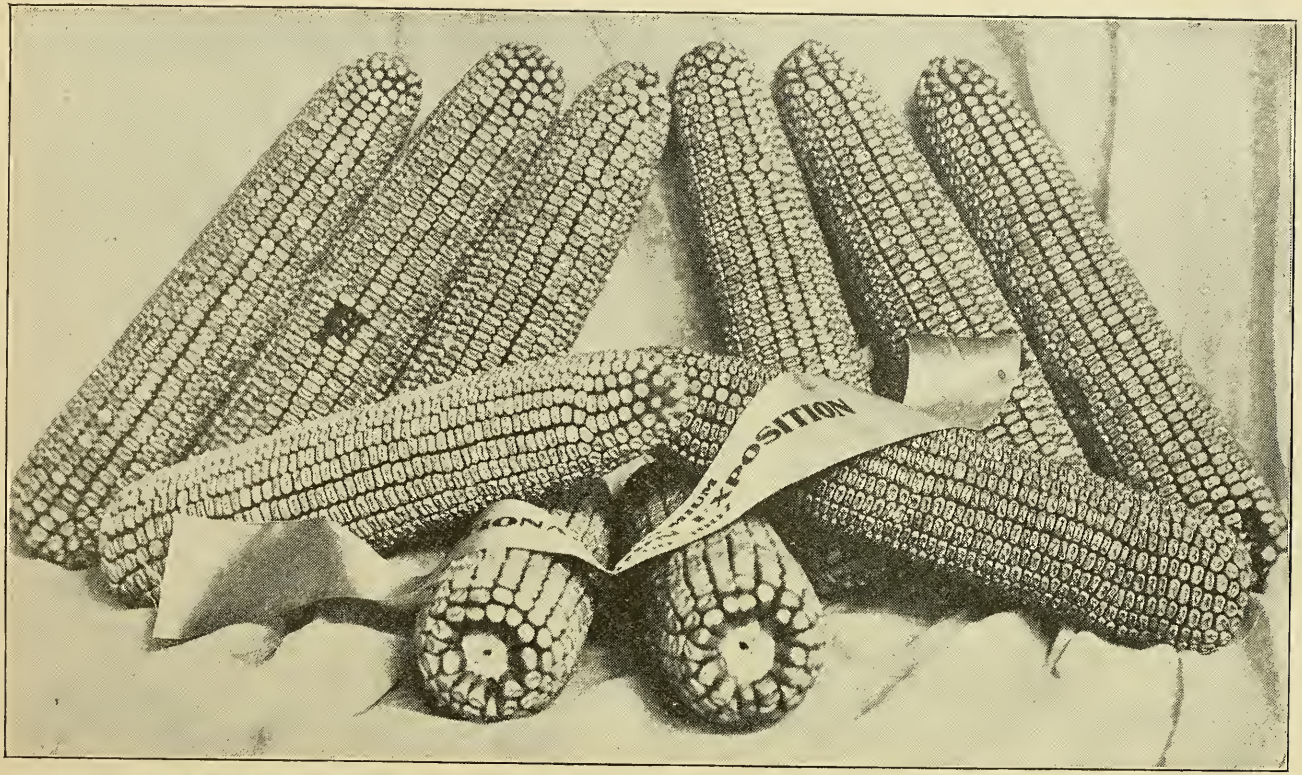

PLATE 3.—Another sample of corn that the National Show of 1907 said was first class. The sample shows all of the Reid's Yellow Dent characteristics. Note the bridge dent on almost all of the kernels, the rounded butts of the ears, the well filled tips.

CORN—SCORE CARD.

Name..... Class.....

Number of Sample..... Date.....

I.	Will It Yield?.....	25 points
II.	Will It Ripen?.....	25 points
III.	Will It Grow?.....	25 points
IV.	Does It Show Improvement?.....	25 points
	Total Perfect Score.....	100 points

That is, if the ear is perfect it will have a score of 100. Some one will say that there are no perfect ears. Perhaps there are not, but the judge can combine the perfect points that he has seen in other ears into an ideal, and by this he can tell how nearly the actual comes to the ideal.

On all score cards the name of the judge should be placed. The term "Class" refers to the kind of corn, or the section from which it comes. For example, "yellow," or "northern half of county," or "Reid's Yellow Dent," or "Pop corn." Each sample must have a number. This number refers to the person who is displaying the corn. Of course the judge goes only by the number. The date is usually put on the card so that in case of a dispute over the matter later there will be that information at hand. It is a pretty good habit to date everything. There is no telling when that fact will be needed. In taking up the first point, Will It Yield? the card will further be divided into eleven parts as follows:

I. WILL IT YIELD? 25 POINTS

That is, will it yield well; has it constitution; can we depend on it even when conditions are unfavorable?

		Perf. Score	1	2	3	4	5	6	7	8	9	10
I	**Will it Yield?**	25										
1	Size of Ear 6											
2	Solidity or Heaviness 4											
3	Depth of Kernels 3											
4	Cheerfulness 3											
5	Size of Germs 2											
6	Fullness of Middle 2											
7	Filling of Butts 1											
8	Filling of Tips 1											
9	Space at Cob 1											
10	Furrows between Rows 1											
11	Size and Condition of Cob 1											

This first part is the most important of the four. Why? Because the bushels per acre is all that makes the raising of corn profitable. If we forget that, even though we know all else there is bound to be a failure. How can this point be told by looking at the ears? That is a fair question. It cannot. Then why are we studying the ears at all? Because there are some points which if they are observed will tell to a pretty fine degree of accuracy whether the ears will yield or not. The eleven items which are given above, if the ears show the points developed as they should be, will indicate high yielders in ninety-nine cases out of a hundred. That is the reason for the study. The ears do tell a story. And the ears that will produce much corn are the ears that are needed. But they must have the ability to produce that corn when conditions are not favorable. It takes the very best of ears to do that.

Explanation.

1. Size of Ear—With the proportion of corn to cob being the same, the larger the ear, the greater the yield of shelled corn, providing the same number of ears are raised on an acre. The ability

to mature limits the size. This last statement emphasizes the fact that there is no hard and fast line between the various parts of the card. Here the fact that an ear does not mature well will reduce its power of yielding. But it is the yielding that we are thinking of at this time.

2. **Solidity or Heaviness**—If the ear is dry, the firmer it is and the heavier in proportion to size, the greater is the weight of shelled corn per acre and the better the quality. This point and the one before it says that if the ear is a heavy one, and every other ear in the field is a heavy one, there will be a greater yield than if there were light ears. For the market today takes corn as well as other grains by the weight.

3. **Depth of Kernel**—If the corn has matured, the deeper the kernel the greater the proportion of corn to cob, and consequently the better the yield of shelled corn. The depth of the kernel should carry out well toward the tip of the ear. That is, all of the kernels of the ears should be as nearly like the center kernels as possible.

4. **Cheerfulness.**—A bright, clear color and a clean, healthy appearance of the grain and cob of an ear indicate sound corn of good quality and that it will produce strong stalks when planted. It will do something even under unfavorable conditions. This point can be told as easily after a little practice as whether a person has a bright eye or not.

5. **Size of Germs**—Large deep germs show high feeding value and ability to produce strong vigorous stalks. Of course there is a limit to the size of germ, but the larger the germ under reasonable limits the higher the yield in the field will be. Experiments have shown this to be true.

6. **Fullness of Middle**—Fullness in the middle of the ear indicates vigor, good weight of ear, and a high proportion of corn to cob. It is about the same as the heart girth on an animal. It shows that there is some strength worth having.

7. **Filling of Butts**—A butt well filled with uniform kernels indicates proper development of the ear and stalks, a strong shank that will hold the ear on the stalk in high winds, and a high proportion of corn to cob.

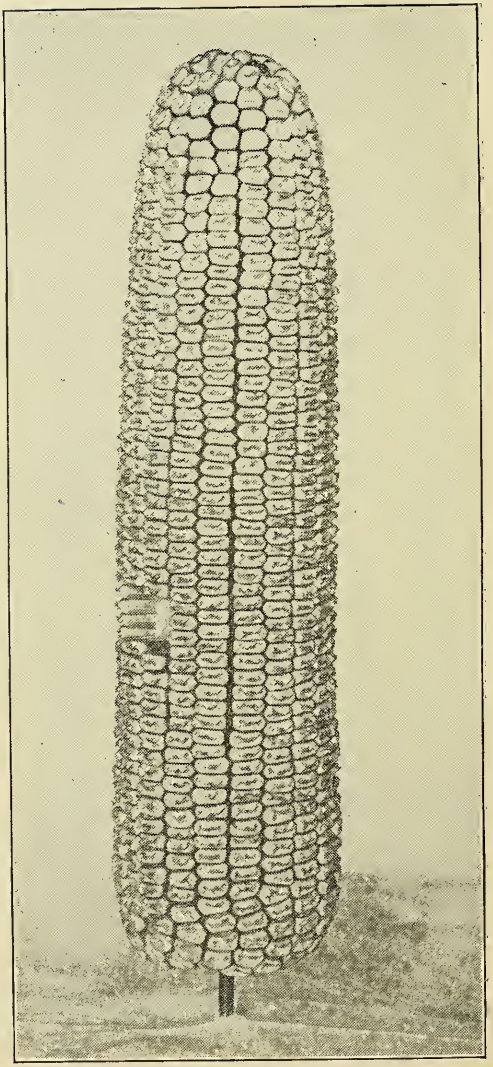

PLATE 4.—The National Show in 1908 said that this was as near to the ideal in corn as nature was apt to produce. Certainly it has straight rows, the kernels are rightly spaced at the crown, the tips and butts are well filled and notice the kernels right in next to the cob. There is no space wasted between them. The ear shows much uniformity.

8. **Filling of Tips**—A tip well filled with strong uniform kernels indicates complete development of the ear, and a high proportion of corn to cob. Time was when these last two points were the first that were examined by the judge for he thought that they were the important ones. That time has passed. While a good tip and a good butt are to be desired, they must not be secured at the sacrifice of other features. It is commonly known that breeding for a well filled tip will in the end shorten the ear. That means the yield will be reduced. When the study on Breeding Corn comes we will see how the evils such as this may be overcome.

9. **Space at Cob**—Space at cob is a very definite indication of a low proportion of corn to cob. It may indicate immaturity, or improper development and consequently low feeding value.

10. **Furrows Between Rows**—Wide furrows between rows indicate a low proportion of corn to cob and the running out of the corn. Closeness at the crown, lack of furrow, usually indicates space at cob. There should be sufficient furrow to allow the corn to dry out readily.

11. **Size, Density and Condition of Cob**—A large, heavy, woody cob indicates a low proportion of corn to cob. A cob may be small and still be heavy. A medium sized, fairly light cob indicates strength and proper proportion of corn to cob.

How to See.

Stop right here. Have you been examining the corn that you have? If you have you will have discovered that to see things on the ear of corn are not so easy, after all. How can the right estimate be placed on the ears?

1. **Size of Ear**—This point under "Will It Yield?" is not as important, in one sense of the term, as it is later. Here the important thing is to notice whether the ear is well balanced, length with circumference. The ear ought to be well developed. That is what is meant. Hold up two ears and decide which one has the best size. Do not give the first place to the biggest ear. That is not what is wanted. If the ear is big and as well has the proper proportions, that is the ear to choose, and to give the highest score.

2. **Solidity or Heaviness**—Of course the best way to tell this is with the scales, but where there is much difference in the weight of the ears the hand will be able to tell which is the heavier and which as a result ought to receive the highest score on that point.

3. **Depth of Kernel**—While you can see the depth of the kernel at the butt, that view may be misleading. The center kernels are the ones to examine. They represent the strength of the ear. If they are poor there is not much reason to look for good kernels elsewhere.

4. **Cheerfulness**—Hold the ear in a good light, and each ear, one after another, in that same light. And then look carefully. There are many possibilities for mistake in this point. A slight shadow may make an otherwise good ear appear as if it were dull and worthless.

5. **Size of Germs**—Do not trust to the first kernel that you examine. Look at several. While the outside appearance may be important, and it should not be overlooked, the depth of the germ should be examined. To do this it is necessary to cut the germ. Here as elsewhere it will be found necessary to have at hand a penknife.

6. **Fullness at the Middle**—Lay the ear down on a flat surface. Does it touch all the way along. It ought to. If there is any place that it does not touch that place ought to be at either end, not at the middle. And yet there ought to be no tapering towards the ends of the ear.

7. **Filling of the Butts**—There is not much difficulty here. The rows ought to come out regularly to the end, and be of good depth. A glance will tell whether this is true or not.

8. **Filling of the Tips**—Likewise the tips should be filled well as is consistent with a well formed ear otherwise.

9. **Space at Cob**—There is only one way of seeing this and that is to look. And it requires careful looking, too. Several of the kernels must be removed. There should be little space between the kernels near the cob.

10. **Furrows Between Rows**—This, of course, can be told at an outside glance, but the entire ear should be noted.

11. Size, Density and Condition of Cob—By looking at the butt one may be able to tell whether the cob is of the desired sort or not. There is no rule that can be laid down here, but after several cobs are examined, the student will see a great deal of difference. It may be necessary in the final analysis to break the ear to determine the density.

How to Arrange the Sample.

So far nothing has been said in regard to the way that the ten ear sample should be arranged for study. We said that there should be some way of keeping the ears separate, such as nails driven in the table, or pieces of wood or corn stalks between the ears, but there is a part that is of greater importance than that. The ears ought to bear an individual number. You will notice as you glance over the score card that there are, at the heads of the columns, numbers. These numbers are intended to correspond with certain ears. There are several ways that this numbering may be done. One way is to tack on the bottom of the ear a piece of cardboard on which there is a number. Or a rubber band to which is attached a small tag is another handy way. But the point is, some way should be used so there will be no mix-up in the ears. Then the ears should be laid with the numbers running from the left to the right, thus:

1 2 3 4 5 6 7 8 9 10

and the butts should be next the body. Do not study ears when the tips are towards your eyes. If you do, it will mean that you will get a wrong idea of the shape. Besides, there should be some uniform way of doing this work. All judges work in this way.

There is a simple device which combines all of the suggestions that have been given in regard to the arrangement of the cars. It is a board about a foot wide, on which have been nailed small foot strips of wood about 2½ or 3 inches apart. After ten such places have been made on the board you have such a device as will carry easily the ten ears anywhere that you want to do your studying. It is a great deal easier to carry the corn to the light than it is to take the light to the corn.

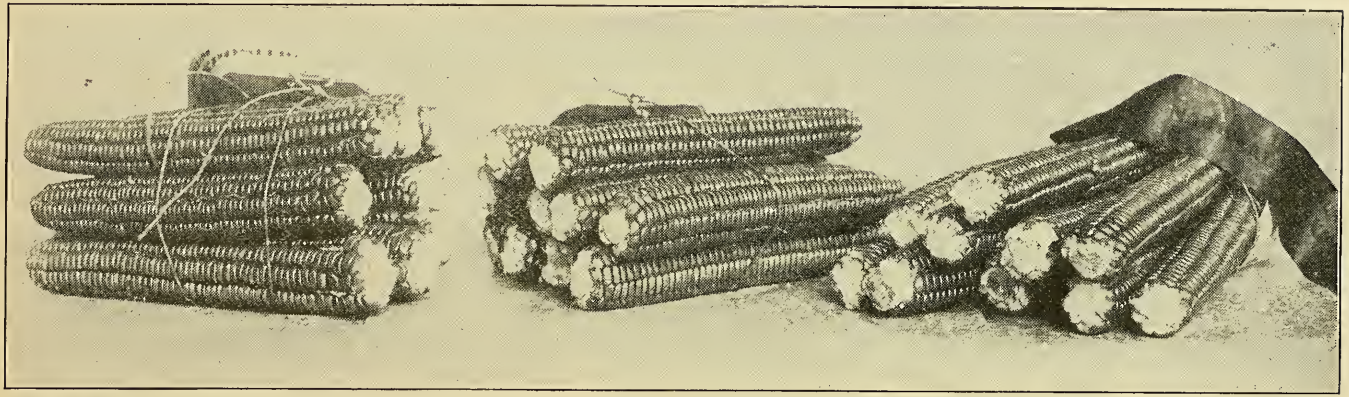

PLATE 5.—The ribbons on this Yellow Flint Corn tell the story that it came from a show. In fact these ears came from the National show. Flint corn is of great value in many places. These ears show how compactly the kernels are placed on the cob. There is little space wasted.

This gives a good start in the study of corn. The next parts of the score card will be taken up in their order. It will be noted that some of the same individual points are considered in the other three main divisions, but it is with a different point of view. Just one example to show this: Size of ear comes under both "Will It Yield?" and "Will It Ripen?" In the first case the question is not a matter of maturity at all; the ear may be mature and it may not; what we want is a large, well proportioned ear. In the second case, however, if the ear is immature and large the judge scores heavily on that point for the reason that the larger the ear the less likelihood there is of it becoming mature in a given growing season. So in the first instance we are thinking of yield alone, in the second of maturity. This same policy fits to all other repetitions of the same point. The next main division is "Will It Ripen?"

II. WILL IT RIPEN? 25 POINTS

That is, will it mature; will it ripen every year; is it safe for the locality? Will it be of good quality?

		Perf. Score	1	2	3	4	5	6	7	8	9	10
II	**Will it Ripen?**	25										
1	Size of Ear 6											
2	Depth of Kernels 4											
3	Sappiness 3											
4	Chaffiness 3											
5	Starchiness 3											
6	Size of Cob 2											
7	Plumpness of Tips of Kernels 2											
8	Adherence of Chaff to Tip Caps of Kernels 1											
9	Adherence of Tip Caps to Cob 1											

It is to be hoped that no one has been marking in the book. Do not do it. You will need the book for reference, and it is an easy matter to rule off a sheet of paper with the few figures that are given here.

1. Size of Ear—The circumference, to a large extent, determines the maturity. The length, in fact the entire size, is set by the

locality where the corn is grown. To give an example of the way corn varies in different parts of the state as well as in different parts of the country, the standards for Iowa are given: For the northern part of the state corn is required to be 8½ to 9½ inches long; for the central zone 8¾ to 9¾ inches; for the southern section 9 to 10 inches. But the point that holds everywhere is that the circumference should be about three-fourths the length of the ear. As was said, the maturity is easily seen in most cases by the circumference, so ears a trifle long, having a circumference of such size that the ear mature well, should not be cut seriously for this excessive length. Large ears showing signs of immaturity should be cut heavily.

2. **Depth of Kernel**—As a rule deep kernels require more time in which to mature than shallow ones, consequently the deep kernels in a short-season zone should be cut more heavily than the same kernel in a district where there is a longer growing season.

3. **Sappiness**—This is easily told. Grasp the ear firmly in the hand. If it gives much, as if it were wet inside, it has the quality of sappiness, which is undesirable. It indicates that the ear has not been freed of the moisture that ought to have left it by the time of maturity. Besides this point (the ease with which the ear may be twisted), a sappy ear is determined by the heaviness of the ear, and the softness of the grain and cob. If the ears have been dried near a fire either intentionally or otherwise, much reliability cannot be placed on this point.

4. **Chaffiness**—When the ear has dried, looseness of the kernels on the cob indicates chaffiness and shows that the kernels have not been properly developed. Chaffy kernels are often indicated by an extremely pinched dent or much space at the cob. Just take your hand and rub along the ear. If the ear is very chaffy there will be a dry rattling sound accompany the process.

5. **Starchiness**—This is the point that may be trusted implicitly. Starchiness is a condition of the kernel caused by lack of development, which causes the whitish, clouded appearance of the kernels of immature corn. It shows most often and most plainly in the backs of the kernels. This indicates that the placement of the food material was checked in the kernel before it was complete. In other words the kernel, and consequently the ear, was not mature.

6. **Size of Cob**—Large, coarse, pithy cobs indicate that the ears

are slow in maturing and that they require much time to dry out after they are matured.

7. **Plumpness of Tips of Kernels**—Shrunken tips on the kernels indicate lack of development. They also indicate lack of vigor, low proportion of corn to cob and poor feeding value.

8. **Adherence of Chaff to Tip Caps of Kernels.**

9. **Adherence of Tip Caps to Cob**—When the kernel is shelled from the cob it ought to separate distinctly from the cob and yet not carry any chaff with it. Point nine is the more important.

A Study of the Kernels.

By this time the student that has followed closely what has been said and has looked at the points mentioned will realize that the most important single part of the ear is the kernel. And yet that is the one that is so frequently overlooked except as it forms the ear as a whole. No greater mistake could be made.

The best way to do is to take out two kernels from each ear the first time that the ears are handled. Take these kernels about one-third the distance from the butt to the tip. They are the representative ones. Lay the kernels out just at the butt or the tip of the ear from which they came. It may be best to lay one with the back up, the other with the germ up. This offers all features of the kernel for consideration. But do not trust to these two kernels to tell the whole story. Especially if the judging is close there may be a mistake. But however that work is done, study the kernel, for that is the part that makes the ear. It is much better to say that the kernel forms the ear than it is to say that the ear shapes the kernel.

The next part of the score card is one that causes much curiosity. How to tell whether an ear will grow or not. As we said in Study Two there is only one way of being absolutely sure of this point and that is to test the ear in the field or in something that is as nearly like the field as is possible to secure. But in the kernel are some pretty sure signs to follow. If they are heeded they will guide the farmer away from the larger difficulties in securing a good stand.

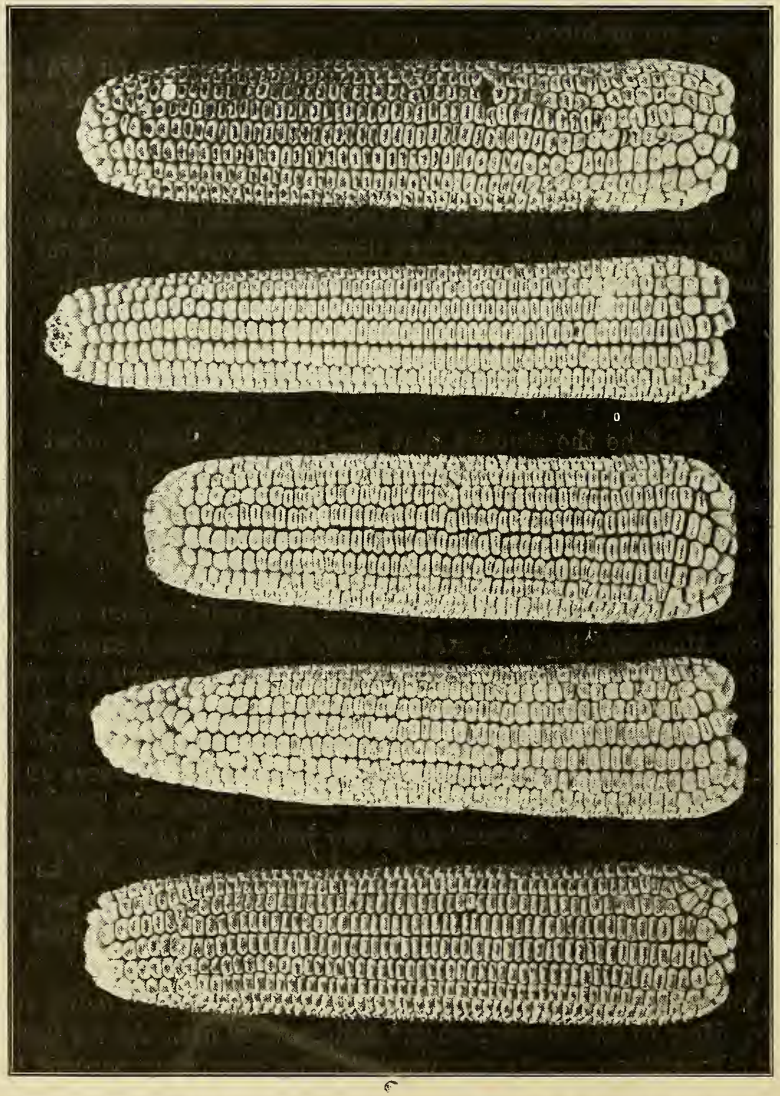

PLATE 6.—Here are some types that will be found everywhere that corn is exhibited. Ear Number 1 is good. Ear Number 2 tapers too much. It has very irregular kernels, and the tip kernels are shallow and smooth, a sign that the corn is receiving little attention in its breeding. Ear Number 3 is too large around for its length. The ear looks as if the kernels were loose on the cob. That would be an indication of immaturity. The proportions of the ear would go to support that idea of immaturity even though it were not touched by the hand. Ear Number 4 is the other extreme. Probably it has a low shelling percentage. In the extreme north, however, there are corns like this which are profitable, since the deeper kerneled varieties cannot be grown. Ear Number 5 shows a weakness just where strength ought to be shown, at the heart girth. The kernels are irregular. While the upper half of the ear is good as the average the lower part spoils the worth of the ear for seed or for show.

III. WILL IT GROW? 25 POINTS

That is, has it vitality; will it germinate; will it all grow and grow uniformly, giving strong vigorous plants?

		Perf. Score	1	2	3	4	5	6	7	8	9	10
III	**Will it Grow?**	25										
1	Color and Condition of Germ and Embryo 10											
2	Sappiness 3											
3	Chaffiness 3											
4	Starchiness 2											
5	Mouldiness of Cob 1											
6	Plumpness of Tips of Kernels 1											
7	Size of Germs 1											
8	Smoothness of back of Kernels 1											
9	Smoothness of Germs 1											
10	Adherence of Chaff to Tip Caps 1											
11	Adherence of Tip Caps to Cob 1											

1. Color and Condition of Germ and Embryo—The germ is the whitish oval portion which covers one-fourth to one-third of one side of the kernel. The embryo is the little sprout or chit which is found in the germ. A yellowish or brownish color of germ and embryo usually indicates that the ear has been wet while frozen before it was well dried, and that it is dead or weakened. A large, soft embryo is likely to contain a large amount of moisture and be liable to damage by freezing. A pale or shrunken embryo indicates lack of development and is likely to produce a weak stalk. The germ should be of a light cream color, and should be neither sappy nor extremely brittle, although in the latter state there are many kernels that will grow. To get at the germ so that you can see all the parts, take the knife and cut off the top layer of the kernel until the embryo is laid bare. You will then be able to see all parts of the germ. At any rate the germ must be opened. It matters little the method used.

2. Sappiness—Corn containing a large amount of moisture is likely to sprout if placed in a warm room, or to be killed by freezing if left in a cold one.

3. **Chaffiness**—Chaffiness caused by lack of full development indicates lessened strength or producing power.

4. **Starchiness**—Shows vigor has been lessened.

5. **Mouldiness of Cob**—Mould around the tips of the kernels or at the butt end of the cob indicates that there is an over-abundance of moisture present and that the germ may be injured by sprouting or freezing. It is well to look carefully for this point.

6. **Plumpness of Tips of Kernels**—Shrunken tips on the kernel are the result of lack of development and so indicate weakness. The germ has been shriveled in the process.

7. **Size of Germ**—Large, deep germs show strength and an abundance of nourishment for the immediate use of the germinating plant.

8. **Smoothness of Backs of Kernels**—The blistering of the back of a kernel shows that it has not dried properly or that it has been frozen while filled with water, either one of which is likely to have killed or weakened the germ.

9. **Smoothness of Germs**—The pulling up or the wrinkling of the face of the germ may indicate freezing or improper drying and should lead to a careful examination of the embryo and the germ. When there are a large number of samples and only a few prizes the judge will only look at the outside of the ear and in a great many cases ear samples may be discarded for their inferior looks, or dead appearance.

10. **Adherence of Chaff to Tip Caps.**

11. **Adherence of Tip Caps to Cob.**

These last two items are true because of the inter-relation of immaturity and weak germs. They should be carefully noted.

THE IMPORTANCE OF DETAILS.

By this time the student begins to realize that there are all sorts of things to be remembered while judging corn, things which are not considered by the average person, and which are detailed in their nature. But it is the details that win out, never the grosser facts. And so the man who is capable of looking after the details is the one that will win and he is the only one who should take up

the matter of corn judging. In other words, to be successful as a corn judge the man must pay attention to small items, and unless a man is going to be successful he had better let the whole matter alone.

The next part of the work is that which will be treated at greater length in the last number of the course. It asks the question as to how much thought man has given to the corn in caring for the crop from year to year. Now-a-days there is little need for the man who will not look out for the yield in years to come as well as for the present crop.

IV. DOES IT SHOW IMPROVEMENT? 25 POINTS

That is, has it breeding; has it a distinct type; will it reproduce itself; has it several years of careful selection and improvement back of it?

		Perf Score	1	2	3	4	5	6		8	9	10
IV	**Does it Show Improvement?**	25										
1	Purity of Color of Grain and Cob 10											
2	Shape of Ear 3											
3	Shape of Kernels 3											
4	Uniformity in Size and Shape of Ear 3											
5	Uniformity in Size and Shape of Kernels 3											
6	Character of Dent 2											
7	Straightness and Arrangement of Rows 1											

1. Purity of Color of Grain and Cob—In color the kernels should be free from mixture and true to the varieties which they represent. Variation in shade of color such as light or golden yellow, pearl white or cream color should be scored according to the variety characteristics. For this work the student should look over the variety descriptions that were given in the first study. A white cob in yellow corn or a red cob in white corn should disqualify the ear unless such color is a variety type which is not frequent. Color is a difficult point to note. The ear should be held in a good light. With yellow corn there is little difficulty in noticing the white caps. They are signs of mixture. But in the white corn mixture is shown in a different way. The sides of the kernels become tinged with yellow. To see them the judge must look between the rows and be-

PLATE 7.—These ears show scrubs and nubbins. The smooth kernels, the space between the kernels at the crowns, the poorly filled tips and butts, the irregular rows, the tapering of the ears, all go to show that the ears have a doubtful parentage.

tween all of them, for each off-kernel is very objectionable. It is well to hold the ear about eighteen inches from the eyes and then turn it slowly until a complete revolution has been made. Whether any other of the facts regarding the purity of the corn are noted or not this one should be, and carefully. It is the first thing that the judge notes, for the reason that the corn that has a mixture of bloods is very seldom indeed a high yielder for continuous years.

2. Shape of Ear—The shape should conform to the variety type, and yet all varieties are conforming to that ear which is cylindrical or nearly so in shape. At least, an ear should be full in the middle and carry well out to the tip. In general, as has been mentioned, the circumference should be about three-quarters of the length. The measurement for the circumference should be taken about one-third the way from the base to the tip. There is a danger of getting the length too great if a tape line is used. It is better to use a rigid rod and cite the length.

3. Shape of Kernel—The shape of the kernel should conform to the variety type. This, of course, would be true, for it has been already said that the shape of the kernel determines the shape of the ear. The shape of the kernel should be full. The kernels should touch at their edges for their entire length. That will make the kernels wedge shaped. A rounding crown gives a smooth appearance and indicates that there has been very little breeding.

4. Uniformity in Size and Shape of Ears—The size and shape of all ears in the sample should conform to the variety type and be uniform for all ears in the sample.

5. Uniformity in Size and Shape of Kernels—The size and shape of all kernels on each ear and of the kernels on all ears in a sample should conform to the variety type and be uniform throughout the sample. This will insure more even stands and such corn from such seed will mature at more nearly the same time than if uneven kernels were planted. In fact, in all kinds of plants as well as animals, uniformity to a point or to a number of points will indicate good breeding.

6. Character of Dent—The later the variety, the deeper the kernel may be and the deeper the dent of the kernel usually is. It has been found that the medium dent is the one that usually yields

the highest, other things being equal. But of course there will be a difference in the different varieties on this point.

7. Straightness and Arrangement of Rows—The rows of kernels should run straight from butt to tip. Any twisting of rows around the ear is objectionable. The arrangement of rows depends on the variety type. For example: Reid's Yellow Dent is distinctly paired, while Golden Eagle is arranged in single rows.

THE CONCLUSION.

The four parts that have been studied may now be placed together and a summary made of the whole card. The four parts make each individual ear score 100, if it is perfect. Of course there is no ear in your sample that is perfect, but add up the columns and put the total score down. Look at the photographs of good ears and see if you are satisfied with the result. If you want to place the ears as the card would have them, then use the space marked "Rank of Ear." Indicate the ear with the highest score as 1, the one next with the number 2, and so on down to the last, 10, which will have the lowest score. The form which will complete the other parts of the card is:

	Perf. Score	1	2	3	4	5	6	7	8	9	10
Total Score	100										
Rank of Ear											

A REVIEW.

Now before anything else is noticed of this work go back and review all of the points that have been mentioned. Go carefully over the work already done, and see if you would make any changes. Put a new ear in the ten and see what difference there is between that one and the one that it replaced. Then you will be able to see points that you have failed to see clearly before and when you start on the variety study the task will be an easy one.

For Variety Study Only.

In some sections there is so much importance placed on the merits of a variety that there is often need of having the various points for the variety differences well in mind. If there is a demand for a score where the variety characteristics are the only ones to be considered the following card will be used to advantage:

Trueness to Type, or Breed Characteristics		1	2	3	4	5	6	7	8	9	10
(1) Shape of ear	25										
(2) Shape of kernel	25										
(3) Purity of color of cob	10										
(4) Uniformity in size and shape of kernel	10										
(5) Purity of color of grain	10										
(6) Straightness of rows	5										
(7) Arrangement of rows	5										
8) Filling of tips	5										
(9) Filling of butts	5										
Total - - 100											

VARIETY STANDARDS

NAME OF VARIETY	Northern Section	Central Section	Southern Section

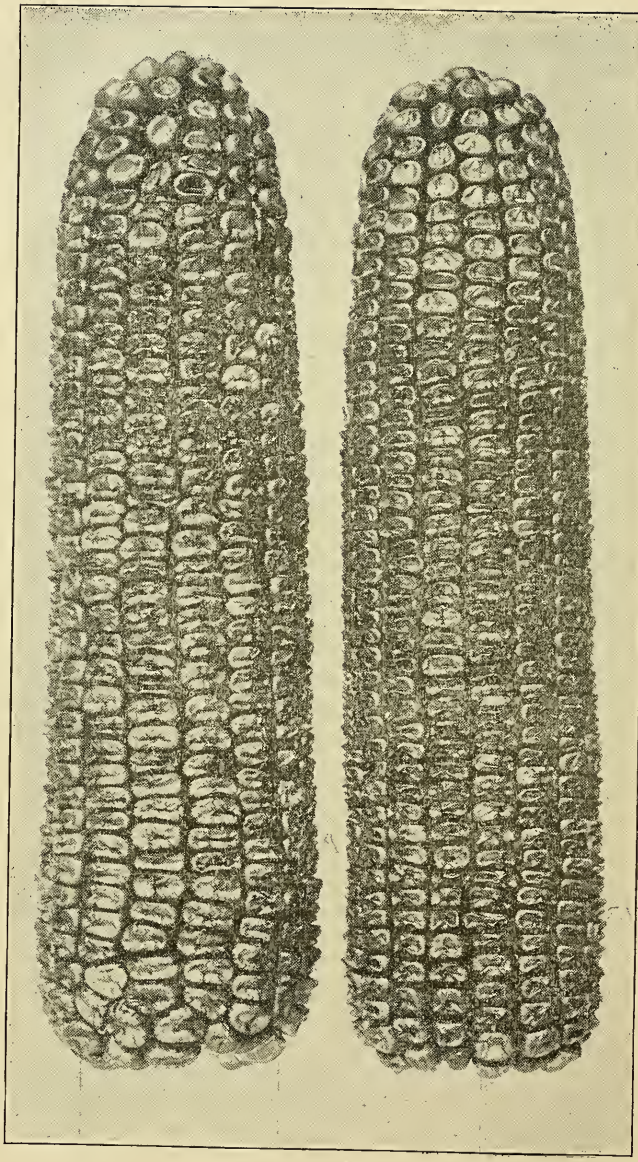

PLATE 8.—The ears from a Northern Show. The short growing seasons will not permit the same kind of dent corn that the South can grow but qualities of good breeding are shown here the same as with the Southern Corn. Note the regular rows, the uniform kernels, the well filled tips and butts. The farther North the crop is grown the shorter the ears become. Some farmers forget this in shifting from one section to another.

It is well to have the different standards for the varieties being studied right on the paper where the work is being done. That is the purpose of the bottom part of this card. Most states that grow a great deal of dent corn have the state divided into at least three sections. But those may be changed from time to time and when they are the card should be made to fit the conditions.

No Fixed Standards.

It might be said right here, for fear that some one will get the wrong impression, that there is no set of rules that will apply in all sections of the United States. In the first place all sections of the country do not raise dent corn. We have been talking for the most part of that kind, for that is the corn that is of the greatest commercial importance, take the country over. But the same things that have been said in this study may be applied with modifications to the sections where dent corn is not raised, but where flint corn, or hominy corn, or starch corn is found. The judge should always remember the use to which the corn is to be put.

For the most part the shows of the country exhibit corn that is intended for seed. As such it ought to be able to grow. Every ear that will not germinate should be discarded. That seems severe, but of what use would dead corn be if it were put in the field at planting time? If the corn is for feed, the shelling percentage would have a great influence. Flint corn would be judged according to the type required; the same general rules of breeding would hold there as with dent corn. And so the judge must adapt himself to the conditions under which he is required to work.

Score Sometimes Demanded.

As we have said, there is really no exact way, all conditions considered, for the placement of corn under the score card scheme. But there are often communities which demand that a card be used. It then becomes a part of the work of the judge to score the samples as well as to place them. The most of the samples are ten-ear in size. That calls for a different card than the long one used in this

study thus far. And so all of the states have adopted ten-ear score cards, by means of which the ten-ear samples may be scored and very frequently with much accuracy. In rapidly studying a sample of ten ears the student should use this card. Of course, now we are considering the ten-ear samples. The work before this has been with the single ear in mind. Note this card and see how carefully all of the points are reviewed. It is the one now in use in Iowa, but the other corn growing states have similar ones.

SCALE OF POINTS	NO. OF SAMPLE								
		5	9	14	6	etc.			
1. Uniformity and Type									
2. Maturity and Market Condition									
3. Purity (a) Kernel									
(b) Cob									
4. Shape of Ear									
5. Length of Ear									
6. Circumference of Ear									
7. Shape of Kernel									
8. Uniformity of Kernel									
9. Character of Germ									
10. Butts									
11. Tips									
12. Space Between Rows									
13. Proportion Shelled Corn									
TOTAL									

STANDARD OF VARIETY

Length.....

Circumference.....

Proportion of Shelled Corn.....

Name of Variety.....

.....Date.....

Name .....

How to Apply the Score Card.

1. **Uniformity and Type (10)**—All the ears of an exhibit should conform to the variety or the prevailing type, and should be uniform in size, shape, color and indentation. For each ear differing in size, shape, color or indentation, from the variety type, cut from one-fourth to one point.

2. **Maturity and Market Condition (15)**—Ears should be well matured, firm and dry. Each ear showing a marked degree of looseness of kernels should be cut not to exceed one and one-half points. For ears less imperfect in this respect, a cut may be made varying from one-fourth to one and one-fourth points. Ears showing rotten spots or injuries of other sorts should be cut from one-fourth to one-half point each. One dead ear shall be cut five points. Two dead ears shall bar the exhibit.

3. **Purity-Kernel (5)**—Kernels should be free from mixture with corn of opposite color. Mixture in yellow corn is shown on caps of kernels; in white corn, on the sides. For each mixed kernel on the ear, cut two-tenths of a point. Should there be more than twenty-five mixed kernels and less than fifty, deduct five points from the total score. For fifty to one hundred mixed kernels, deduct ten points. For greater mixture the sample shall be barred.

Purity-Cob (5)—Cobs should be of one color; in yellow corn, usually red; and in white corn, white. For pink cobs, cut one-fourth to one-half points for each, according to shade. For each cob of opposite color, a cut of five points shall be made.

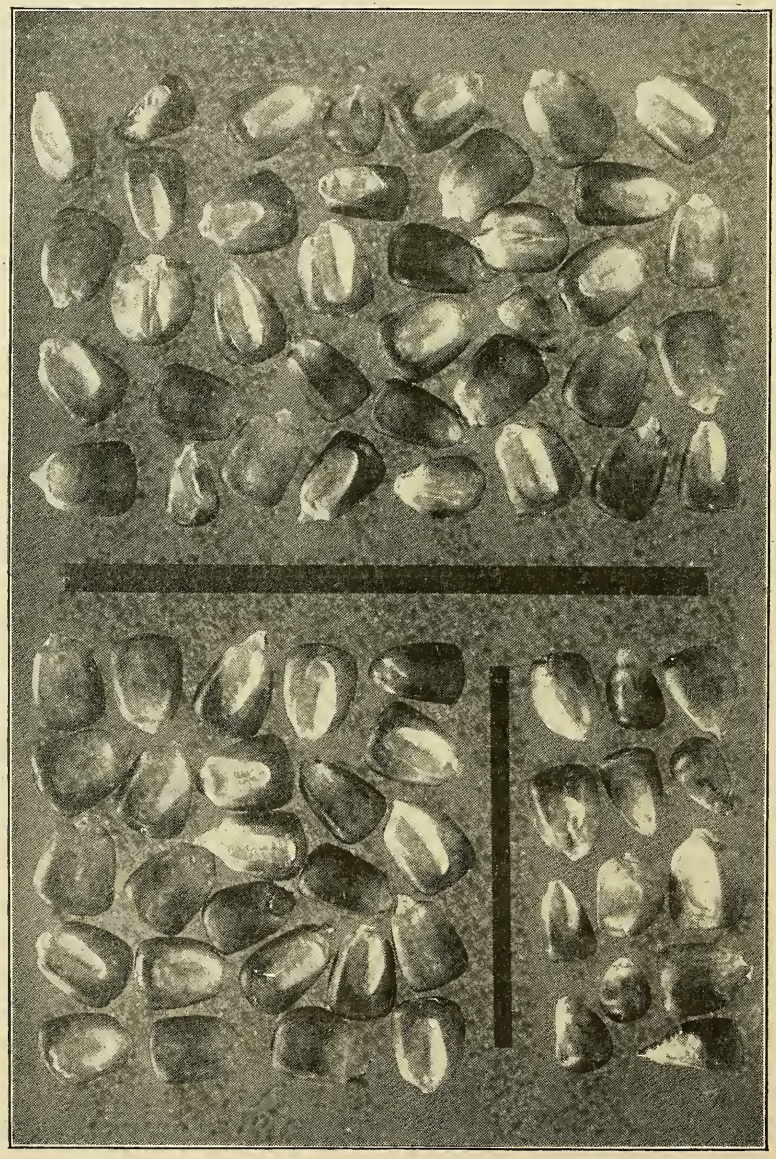

PLATE 9.—The larger lot consists of kernels. They are graded for the planter. The small is the culls. The other lot is made up of kernels graded. The attempt is to get all of the kernels on each ear as nearly alike as possible so that the lot which in this photograph is the smallest shall be as nearly nothing as possible. That calls for uniformity.

4. **Shape of Ear (10)**—Ears should be as nearly cylindrical as possible and have straight rows running from butt to tip. These characteristics usually indicate a high per cent. of corn to cob, and a large number of kernels of uniform size and shape for planting. Cut one-fourth to one point for each ear that tapers too greatly or in which rows are twisted or irregular.

5. **Length (10)**—Add together the deficiency and excess in length of all ears not conforming to the standard for the variety and for each inch thus obtained, cut one point. Should the deficiency exceed ten inches a cut of two points for each additional inch should be made on the total score.

6. **Circumference (5)**—The deficiency and excess in circumference (measured one-third the distance from butt to tip) of all ears not conforming to the standard of the variety shall be added together and for each inch thus obtained, a cut of one-half point shall be made.

7. **Shape of Kernel (5)**—The ideal kernel is slightly wedge shaped, but not pointed. The length is, approximately, one and one-half times as great as the width at the widest part. The thickness of the kernel should be carried well down to the tip. For each ear showing poor shape, cut from one-fourth to one-half point.

8. **Uniformity of Kernel (5)**—The kernels from the different ears should be of the same size and shape. For each ear with kernels differing from the prevailing type, cut from one-fourth to one-half point. The individual kernels on each ear should also be uniform.

9. **Character of the Germ (10)**—The germ should be large, full, smooth and bright, not blistered, shriveled or discolored. When broken, it should show a fresh, oily appearance. Cut not more than one point for each ear showing inferior germs.

10. **Butt (5)**—The ideal ear should have a butt well rounded out, with deep kernels spaced in regular rows, solidly and evenly compacted around a clean, cup shaped cavity. The cavity should indicate a medium or small shank.

11. **Tips (5)**—The tips of the ear should not be too tapering and should be filled out to the ends with deep kernels in regular rows. Tip kernels should not be glistening and shot shaped. The ideal tip is completely covered, but if kernels are deep and regular

to the end of the cob no cut need be made. Cut not to exceed one-half point for each defective tip, according to judgment.

12. Space Between Rows. (5)—There should be no open space between the rows of kernels, nor between the kernels in the row, either at the crown or at the cob. Cut not to exceed one-half point for each ear seriously defective in this respect.

13. Proportion of Shelled Corn (5)—This varies with varieties and is largely influenced by the relative depth of kernel and size of cob. The cob should be medium, with diameter about twice the depth of the kernel. Ears indicating a relatively low per cent of shelled corn should be cut according to judgment from one-fourth to one-half point each. When actual shelling cannot take place, estimate is made upon the shape, depth and position of kernels, size of cob, filling at the ends, and shape of the ear. In determining the proportion of shelled corn to ear weigh each alternate ear in the exhibit. Shell and weigh the cobs and subtract this from the weight of the ears, to secure the weight of the corn. Divide the weight of corn by the total weight of ears to secure the per cent shelled corn. For each per cent short of the standard of the variety, one point cut shall be made.

In following the above rules do not get confused. Go slowly, take each point at a time, and soon the entire card will be plain. There is a reason for each statement, and that reason is based on the fact that we are attempting to get for the farmers everywhere more good corn per acre. See if you can figure out how each point aims at that end.

How to Judge a Show

Now if you have mastered all of the ideas that have been presented you are ready to judge a show. It may be that you will not have the opportunity. Your greatest benefit will come in the use to which you put the ideas on the home farm. But you should have some idea of how to go about it, at any rate.

You have been at some show or other at some time in your life. I have no doubt that you have seen a great many shows, and perhaps a large number of those have been corn exhibitions. If so, you know how the samples are arranged. There are samples of single ears, of

ten ears, of thirty ears, of bushels. These ought and probably will be arranged in a convenient place for the spectators, but that does not mean that they will be in a convenient place for the judge.

So the first thing for the judge to do is to demand a place well lighted, with a table on which the corn may be laid. It is one thing to demand and it is quite another thing to get what you are asking for. So in the case you demand a place where the corn will be in the light and where you will be alone with it, do not expect it. If you get it, be very thankful. If you do not, just be resigned and do the best you can.

Various classes will be arranged. Take these one at a time. Do not judge single ears for a time and then turn to bushel samples. If you start with the singles keep with them until you are through with them. Then take up what you find to be most convenient and finish that. Answer questions where that is convenient but remember that your business is to judge the corn. Do not pay attention to the band that is playing on the street corner, nor the roosters that are crowing near your elbows. Judge the corn while you are at the work and then you can play.

How to Conduct a Show.

But the work of the judge would be much easier in most cases if the men who had charge of the show had properly taken care of the preliminaries. And so a word here in regard to the methods used in preparing for the show will be in place.

To begin with, there must be interest in the show before it is started. So there must be some one who will take the responsibility of management. There are many ways that an organization may be effected; in fact there may be no permanent organization. However, it is best to have a permanent body that will carry on the show each year or two in order to compare the corn of one year with another. If there is an organization, the officers of it will, of course, be responsible for the management. And their first duty is to get enthusiasm instilled in all the farmers and in all of the town folks that have gumption. The rest need not apply. How to do this is a question. There are no ways that are successful in all places. If at all possible get everybody financially interested. Let the merchant offer prizes

PLATE 10.—Butts and tips that show characteristics of worth. The length of the ears has been maintained even though the tips are covered.

of money and of goods. Money is much the best. Then give him some free advertising. Do it right too. Do not try to save money, and forget all else. You always lose by it. Make the show worth while. The farmers who have not noticed the matter during the first few newspaper announcements that were made will come around when they see that there is money in it. And then each one always has the hope that he may beat neighbor Jones who has already entered some corn. If advertising is done unstintingly there will be interest unless the county is "clear dead."

Prizes of this sort will mean a good many samples of corn. The show will be properly divided into classes. We will say that the county is the territory concerned. Then it will be divided perhaps as follows:

1. Northern Part of County.

Class A ..... Yellow Corn—ten ears.
Class B ..... White Corn—ten ears.
Class C ..... Mixed Corn—ten ears.

2. Central Part of County.

(Same as North.)

3. Southern Part of County.

(Same as North.)

That makes nine classes. Probably besides this the single ear classes should be made. But the point is that there ought to be a good classification. Then no one from the part of the county where it is impossible to grow large corn will be out of sorts at the management because their corn was put up against the corn from the ideal section. And besides that, it aids the judge in his work.

After the classification has been decided upon there should be some definite date set for the entering of the corn. There is no reason why the corn could not be in, a week or ten days before the show. A date should be fixed and then held. That is if October 30 be the date when corn is to be in the hands of the secretary of the show that should be definite. No corn should be accepted after that date. That may seem inconvenient, but there are all sorts of ways of getting the corn in if there is a will to hold up to a set of rules. Of course it will be necessary to have the rules published quite widely. Together with

the date should be named the place. The old fashioned idea that the corn could be left anywhere in town, just so that on the day it was taken to the place of exhibit, is passed. The corn should be at a definite place at a definite time. Nothing hinders the judge so much as to have samples continually being entered after the judging has commenced.

The arrangement of the samples in the room is also of great importance. **Be sure that the room is well lighted.** No person can tell good from bad corn in a poorly or artificially lighted room. Take a room in the hardware store, or in the grocery, or above the butcher shop, any place providing it has good light. Then have the samples laid out. Boards laid across wooden horses make a fine table for such work as this. The ten ear samples should be laid out neatly with the tips of the ears to the top, or in other words away from the spectator. The ten ear samples may be separated one from the other by nails driven into the boards. Fixed in this way the ears are easily seen by the judge.

A room with the samples neatly arranged, and with some local decorations will attract visitors and there will be much profit to all concerned.

The judge will be guided by numbers on the ears and samples. These numbers will be in the hands of the secretary of the show. After all the work is done the prizes are awarded by number by the judge. The secretary locates the name of the individual and the premium is sent.

Studying by Newer Methods.

There is another method of studying corn that might be well for us to consider at this time since we have been away from the actual subject of the study for a little while. It is known as the COMPARISON METHOD. That is there are no figures to be used at all. The various points of the ear are noted as they compare to the same points of another ear. This system usually uses five ears for study rather than ten. Ear one is compared with ear two, two with three, three with four, and four with five. In other words the ears are placed at the start without reference to score card figures at all. The following sheet which is the common one used will bring out that point:

CORN—Comparison Sheet

*Date*_____ *Student's Name*_____

*Name of Variety*_____ *No. of Sample*_____

Rank the ears of the sample or the several exhibits according to the qualities mentioned below.

	FIRST	SECOND	THIRD	FOURTH	FIFTH
1 Is it adapted?					
Is the ear of proper size to grow under your soil and climatic conditions?	4	3	1	5	2
Will it ripen as judged by the hardness and dryness of the ear, brightness of color, etc.?	4				
2 Will it yield?					
Weight of ear		4			
Length and proportion		4			
Depth of kernels	4				
Space between kernels	4				
Filling out of butts and tips		4			
3 Will it grow?					
Firmness and dryness	4				
Weight of ear in proportion to size	4				
Brightness of color	4				
Plumpness of kernel at tip	4				
Adherence of cob chaff to kernel	4				
Color of germs		4			
Blisters	4				
Freedom from mold and rotten kernels		4			
Freedom from breaking off of tip caps	4				
4 Does it show improvement?					
(Has it a distinct type? Is it the right type? Does it show selection and breeding?) Is it uniform in		4			
Size of ear	4				
Shape of ear	4				
Indentation	4				
Color of grain and cob		4			
Number of rows and size of kernel	4				
RANK OF EARS					

It will be noticed by the outline that ear 4 is first in the point of size under "It is adapted," ear 3 is second, ear 1 is third, and so on. After all of the points are covered the student can easily get the best ears picked out for if ear 4 appeared as it does in the outline shown, there would be no question as to it for the first place among the five ears. It would be difficult to handle ten ear samples with this method.

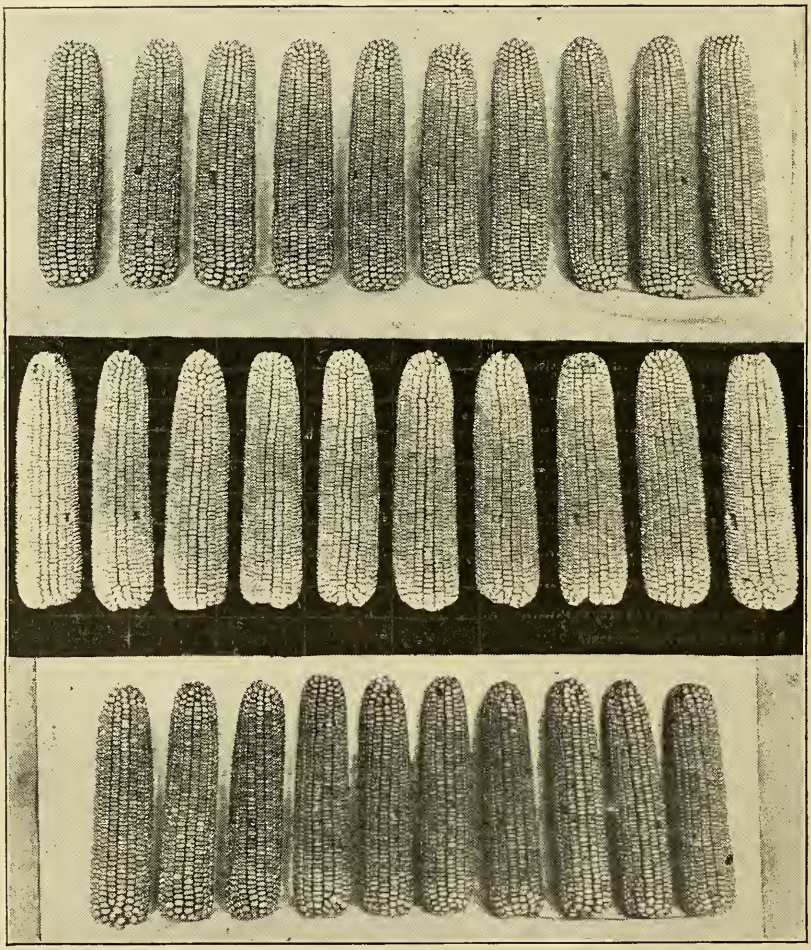

PLATE 11.—Here are three ten-ear samples that have desirable variety characteristics. The top lot is a southern type of Reid's Yellow Dent. Can you place the middle ten ears as to variety? The lower lot is a local type of yellow corn grown in Indiana.

Placing Corn.

All that has been said and all that has been done by the student up to this place has been done with the object in mind of familiarizing him with the details of corn—the ear as it is usually exhibited. But the score card and the written sheet must be thrown away when the practical, workable times come. That demands a quick knowledge of every point so that a decision can be placed on the ear, not on any one point about that ear. We call that work "placing corn." At such a time there is no one to help out, the judge is thrown upon his own responsibility and knowledge.

The best method is to discard those ears or samples that show no signs of making the first place. Leave only the first few best ones in the race. A hasty glance will many times locate the bad ones. Put the time that you have on the ears or samples that are close in the race. Be sure that you are accurate. Do not make any guesses. Then, having placed your decision, be ready to stand back of it. Of course the stubborn man is not what is wanted, but the man who places on reason consequently has a right to be firm.

There may come a time when an explanation is asked. Always give it. This takes training and familiarity with the subject. But the judge ought to be able to express himself on the things over which he has just gone. If he is, the auditors cannot but be satisfied for he has given to them reasons which are satisfactory to himself.

Judging Contests.

Over the country there is a gradually enlarging fancy for the corn judging contest. In this the boys and the girls are trained to judge corn and give their reasons for the placement. Prizes are usually awarded for the best work done. In the awarding of these prizes the statement made by the contestants in regard to the merits and demerits of the corn at hand has a great deal to do with the winning. The object is to give the reasons quickly, yet completely. The following are the ordinary methods for oral reasons on placements:

Methods of Giving Oral Reasons.

This is a sample of (the variety name) Corn. I place this sample 2-5-3-4-1.

Ear No. 2 is placed over ear No. 5 in general appearance, breed type, and shelling percentage. In general appearance No. 2 excels No. 5 because it is a more symmetrical, more vigorous, productive looking ear, carrying its circumference more uniformly to the tip, and having a slight advantage in constitution as is shown by its greater circumference. Ear No. 2 also has an advantage in filling of butt and tip. In breed type No. 2 is placed over No. 5 because of a slight advantage in shape of ear, superior color of grain and of cob, and an advantage in shape of kernels. Ear No. 2 excels No. 5 in uniformity and regularity of kernels.

No. 5 is placed over No. 3 in general appearance, type and shelling percentage. No. 5 has an advantage in general appearance, because of size, stronger middle and superior filling of butt and tip. In type No. 5 has the more characteristic (variety) dent, conforms more nearly to the type in shape of kernel, and excels in straightness and pairing of rows. No. 5 has a decided advantage over No. 3 in shelling percentage because of deeper kernel, and smaller cob. Therefore No. 5 is placed over No. 3 in general appearance, breed type and shelling percentage.

Between ears No. 3 and No. 4 it is very close. They are about equal in general appearance, breed type and in size. However, I prefer No. 3 because it is more mature as is shown by the chaffy starchy kernels of No. 4. No. 4 also has a few blistered kernels and is inclined to be a little sappy.

Ear No. 4 is placed over ear No. 1 in breed type, and so on.

Note. In giving reasons system and method are necessary, but mechanical order should be avoided. The method will depend upon the originality and ingenuity of the judge and must vary with the kind of sample. The points to be considered are arbitrary, but in the systems which have been used here at Ames, and which are the basis for the system given are as follows:—

General appearance, breed type, size, maturity, uniformity and regularity of kernels, shelling percentage.

Where there is to be a great deal of judging and the written reasons are desired the following blank is most convenient:

Placing of Sample

.....First; .....Second; .....Third; .....Fourth; .....Fifth

Reasons

.....First is placed over .....Second because .....

.....

.....

.....

.....

.....Second is placed over.....Third because .....

.....

.....

.....

.....

.....Third is placed over.....Fifth because .....

.....

.....

.....

.....

.....Fourth is placed over.....Fifth because .....

.....

.....

.....

.....

The Plant Not to be Neglected.

So far all of the talk and all of the efforts have been on the ear itself, so that there may be some one who has forgotten that there is another part of the corn industry just as important. It is the plant that produces the ear. Study the corn in the field. That is the only way to learn it. We must pay some attention to the corn plant.

You know what the score card is, that is, what it means and how it should be used. So you will look down the columns of this new card with much interest.

SCORE CARD FOR CORN PLANT

NAME OF SCORER_____ DATE_____

ROW NO._____ VARIETY_____

		1	2	3	4	5	6	7	8	9	10
I. ROOTS 5											
II. STALK 20											
A. Stem 15											
1. Color	5										
2. Height	3										
3. Proportion	3										
4. Straightness	2										
5. Size of Nodes	1										
6. Length of Internodes	1										
B. Leaves 5											
1. Color	2										
2. Size	1										
3. Number	1										
4. Condition	1										
III. TILLERS OR SUCKERS 5	5										
IV. EAR 55											
A. In Case of One Ear 55											
1. Height	5										
2. Length and Size of Shank	5										
3. Position	5										
4. Size	20										
5. Shape	10										
6. Filling of Tip	5										
7. Covering of Tip	5										
B. In Case of Two Ears 55											
(Larger) 35											
1. Height	3										
2. Length and Size of Shank	3										
3. Position	3										
4. Size	15										
5. Shape	5										
6. Filling of Tip	3										
7. Covering of Tip	3										
(Smaller) 20											
1. Height	1										
2. Length and Size of Shank	1										
3. Position	1										
4. Size	10										
5. Shape	3										
6. Filling of Tip	2										
7. Covering of Tip	2										
V. TASSEL 5											
1. Size	3										
2. Shape	2										
VI. FREEDOM FROM DISEASE AND INSECT INJURIES 10	10										

Note. I. A score of zero in any one of the six main headings disqualifies the stalk.
II. A stalk need not be deficient in all points mentioned under the respective headings to score zero in a particular heading.

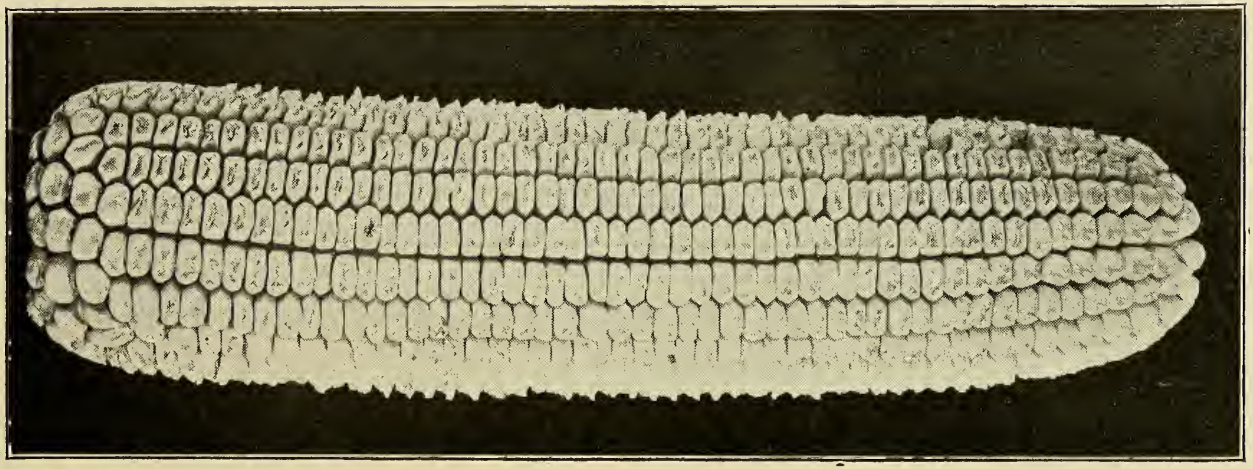

PLATE 12.—This ear represents a type that has been winning in many of the shows. The dent is different from the Johnson County White, and Reid's Yellow Dent but the shape of the ear is good, and the kernels are deep. It is raised in Southern Indiana.

The explanation of these points in judging corn is very interesting. It reveals to anyone the largeness of the subject.

I. ROOTS.

It would seem that more than five points should be allowed for roots because without sufficient root development a corn plant is worthless from the standpoint of selection and breeding. In judging however, the roots are so hidden that no estimate can be made as to their extent and development by the eye. On the other hand, observe the brace-roots closely. Try the stalk to see how firmly it is fixed in its place.

II. STALK.

A. Stem.

1. **Color**—Color indicates vigor or the lack of it. The dark green displayed in a growing stem is indicative of healthy assimilation of plant food. Stems showing streaks of red or yellow should be discriminated against.

2. **Height**—Height must be judged from the variety type. The season and length of time required for maturing should be considered. If the judging is done later in the season and the stalk shows by its excessive height that it will never mature, then it should be scored closely. A tall growing stalk of Legal Tender or Reid's Yellow Dent in Southern Iowa is in keeping with the season. However, in the Northern Section a decrease in stature is necessary. The Silver King, a variety originated in Northern Iowa, is short growing. It will be found that hereafter shorter stalks will be selected than formerly.

3. **Proportion**—It is essential, at present that a corn stalk be well proportioned. With increased size of ear which is now being produced the stem below must be correspondingly larger and stronger. To accomplish this end the distance below the ear will necessarily be shorter. Above the ear only fair length is required to lift the tassels to the winds. Although stockiness and strength are sought in this part also, a gradual tapering from the ear upwards lends symmetry to the entire stalk.

4. Straightness—A straight stalk indicates strength and rigidity of the cellular structure within. Any bending or bowed tendency should be discriminated against, because indicating injury during cultivation or the result of ravages of the Corn Root worm. A leaning effect shows that the corn is too heavy for the stalk. Broken stalks are disqualified entirely, unless acceptable causes can be assigned of which wind is not one.

5. Size of Nodes—Large nodes or joints which stand out plainly, indicate strong couplings which are necessary to withstand the winds. The size of the nodes near the base of the stalk should be a subject of close observation and study. Nodes should afford sufficient surface for the attachment and growth of the leaf-sheath.

6. Length of Internodes—The lower internodes should be very short to give the whole stem strength and resisting power. Quite often the lower internodes are caused to grow too long because of insufficient light when the plant was very young, due to faulty cultivation—throwing the dirt up around the corn to cover grass and weeds. Above the ear greater length of internodes is not only permissable, but necessary to insure flexibility of the stem in the breezes.

B. Leaves.

1. Color—The dark green color of the leaf of a thriving corn plant indicates that the chlorophyll is actively engaged in preparing the plant food, brought up by the roots for use of the entire plant. Any variation from that color proves immediately, faulty transformation, consequent lack of assimilation, and a weakening of the plant. At the time of the formation of the ear the presence of a healthy color is absolutely necessary for rapid and extended development of the fertilized ovules. Yellow is the first sign of weakness and lack of thrift. Red streaking of the veins and midrib should be discriminated against very closely, because its presence indicates incomplete carbon fixation.

2. Size—A full grown stalk of corn has as much as twenty square feet of leaf surface exposed. The greater the spread of leaf-surface the greater the spread for breathing and digesting. Large leaves act as catch basins and conveyors for falling moisture. Ex-

cessive foliage should be criticised because of the tendency to less ear production accompanying this character.

3. **Number**—A large number of leaves spring from a large number of nodes. The stalk consequently has shorter internodes.

4. **Condition**—A splitting and tearing away of the leaves due to the winds or hail can not be scored against the stalk. However, another stalk which does not show these conditions should be given credit. Stalks which show dead leaves long before maturity should be discriminated against.

III. TILLERS OR SUCKERS.

Tillers are produced because of an oversupply of plant food due to thin planting, rich soil, or excessive moisture. However, as corn in its original form grew several stalks from one seed instead of one as it now does, the frequency and constancy of the appearance of tillers should be closely watched. Stalks alike in other respects, the one without suckers is to be preferred. In discriminating against tillers, their size, number and position should be considered.

IV. EAR.

1. **Height**—The height of the ear will depend to some extent upon the variety, season, soil and locality in which the corn is grown. However, because high setting ears are later in maturing, require a taller stalk and are consequently more liable to being blown over, close observations should be made of this character. Selection has proved that this character can be fixed to large entent in a given variety under similar conditions even though these conditions be conducive to rank growth of stalk. In judging this point keep in mind the comparative degree.

2. **Length and Size of Shank**—A long shank usually accompanies a long slender stalk and both are co-ordinate with a long ear of small circumference. Long shanks are more liable to breaking and allow the ear to droop too early which often causes poor pollination of the silks on the under side. A shank which is too short has a tend-

ency to hold the ear upright even after maturity, which condition allows the entrance of fall rains and results in molding.

A large coarse shank is the only outward indication of a large open butt. Too much refinement in the shank may result in the compressed butt, and accompanying diminished size of the ear.

3. **Position**—Position refers to the angle which the ear forms with the stem. In judging the position, the stage of maturity should be considered. An ear in silk or just pollinated should form a very acute angle with the internode in the groove of which it lies. The angle should gradually widen until as the dent stage comes it has reached 90 degrees. This character deserves close observation.

4. **Size**—(Do not husk the ear unless matured.)—In scoring the size of an ear as it is maturing on the stalk the fact that the ear will shrink both in length and circumference should be taken into consideration. Do not be misled in crediting the ear with size when in reality the husks are overly thick and numerous. It will be well to press gently on the ear in several places. The size of the ear determines the yield so largely that a higher score is here given.

5. **Shape**—Many extremes of shape will be encountered in judging ears on the stalk. Discriminate against the long, tapering ear, the short chubby ear, the slender ear throughout. Because of the greater number and thickness of husks near the butt, more circumference at this point should be looked for. However the taper of the tip should be gradual because the husks cease in extent one after another naturally, in case the ear carries a deep grain along the entire length. Variety characteristics should be taken into consideration.

6. **Filling of Tip**—By gently feeling the tip of the ear the filling of the kernels over the cob can be ascertained quite exactly. In very young corn, in breeding blocks especially, care should be exercised not to press too vigorously. Where the husks do not protect the tip of the ear the filling can be noted with the eye. In years of seasonal drought when many of the tips of the ears lack filling this character should be studied closely. Variety type should here be kept in mind also.

V. TASSEL.

1. **Size**—A large tassel with stocky central stem and large

number of branches indicates masculinity. There are a great number of spikelets which produce not only sufficient pollen but virile pollen.

2. **Shape**—Correlated with a sturdy stalk, is a short yet well-branched and compact tassel. A spindling, extended poorly-branched tassel usually accompanies a weak stalk.

VI. FREEDOM FROM DISEASE AND INSECT INJURIES.

Close observation and an intelligent understanding of the ravages of insects are necessary to score a stalk under this heading. Space is too limited here to describe these points in detail. It should be borne in mind that although attacks of disease and insects are not due immediately to the stalk, yet a stalk so affected shows a weakness in consequence thereof.

From this larger form the following has been derived which is much quicker but omits many of the details. It assumes a larger knowledge of the plant by the student.

Field Score Card of Corn

Date ..... Name of Scorer .....

Variety ..... Where located .....

.....

	Standard	Stalk Numbers						
		1	2	3	4	5	5	etc
1. Adaptability	35							
2. Vigor	25							
3. Height of Plant and height and angle of ear.	15							
4. Uniformity and trueness of type.	10							
5. Weight of ear (estimated)	15							
Total	100							

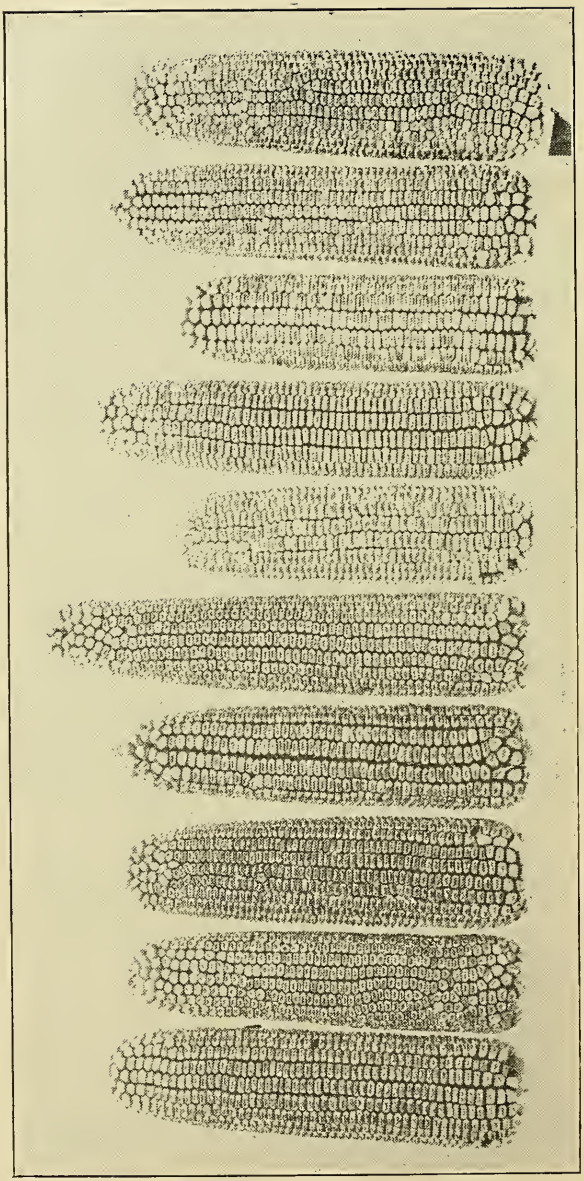

PLATE 13.—Can you find all of the types that have thus far been shown in this picture? Pick out the best ear. The rest of the corn should come some where near that type. But do they? Then the sample has been poorly selected. Notice carefully the different types. If such a sample were sent to a show what should be done with it? If a man's corn is accurately represented by a sample of this kind what can be said as to the general corn crop of that man? How much care has he given the breeding?

How to Study in the Field.

It has been said before in this study that the field is the place to study corn. Yes, it is the place to study all forms of agriculture. But the student who has spent his time in the class room will be lost and unable to handle himself in the field. And there is no doubt in the mind of the most of us that the farmer who has not been studying at all will be at a loss to know what to do with himself when he enters the field for some other purpose than to plow. But the field is the very best laboratory. Let us make use of it now.

Take a part of the field that is the handiest. Do not look for the very best nor the very worst part, but take just whatever is at hand. Take just one row of that part of the field and make that your laboratory. Remember that you are studying the part that produces the ear for which we are all working. Remember the definitions that have already been given and there will be no more trouble. Perhaps it will pay to stay fifteen minutes on one hill. Learn that one and there will be little trouble in mastering the rest.

Notice first the stand. For the average land there should be three stalks in the hill. That is three stalks per hill is supposed to give the highest yield of any arrangement so far. So if there is any short of that there will not be the maximum yield. It will be well to place a stake in the ground near this first hill. Put it in so that there is no danger of it being worked out. It will serve as a guide for study at other times. Then work down the row taking such notes as the following:

1. **Hill number**—Each hill ought to be numbered. There will not be so great a number under study but what that can be done. Then when there is need of referring to the hill there will be no question as to its placement.

2. **Number of Stalks on the Hill**—This is needed for the final figures when the stand is being figured. After a hundred stalks have been noted there will be no difficulty in calculating the stand.

3. **Number of Suckers**—These come for a great many reasons but there is no use for them if the regular stalks develop correctly. If there are very many it is likely that the corn might have been planted more closely without any bad results.

4. **Number of Ears in the Hill**—Of course this will include the number on each stalk. A stalk that does not produce an ear is feeding from the strength of the rest.

5. **Node Bearing the Ear**—While the farmer has passed through his fields many times he may not be able to tell at which node the corn is given off; and as a matter of fact this point is of value in determining whether the corn is a high yielder or not.

6. **Position of the Ear**—That is, what is its height, its angle?

7. **Height of Stalk.**

8. **Circumference of Stalk.**

9. **Number of Leaves**—There is a leaf at every node, so if the number of nodes are counted the number of leaves will be known.

10. **Size of the Leaves**—This is usually secured by taking the length and the width and multiplying. This gives the relative value of the leaves. Of course the leaves are the eating and breathing parts of the plant and we cannot expect any more from the corn plant with scanty lungs than we can from the man who has no life and action.

11. **Brace Root Development**—It has been found that the brace roots will determine to a large extent the rest of the plant. Of course the brace roots are for the purpose of holding the plant in a more erect position. If there are winds of any force these brace-roots will be developed in an abnormal fashion. That is, they will be of good size.

12. This study will not stop with a few days, but will continue for the entire season. That means that the student will be in the field at the time of harvest. Of course that is the best time to study. And then is the time to study the size of the ears—their actual weight. Then the good ears should be taken from the poor ones and the stalks that produced the weaklings noted. The ears that are good for seed should be saved, and the best ones, whether they are good ones for seed or not, should be taken out for the purpose of judging. Comparisons should be made of the ears as they would be judged from the strict standpoint of a critic and from their work in the field. Note closely to see whether the well formed ears are the ones from the best stalks in the field.

Now if the work has been completed step by step there ought to

be some questions that have arisen in the minds of the students. And those questions ought to be settled before going any further. Here are some of the questions that I am sure have been suggested:

1. What four things are the most prominent in influencing the suckering of corn?

2. Is there any sense in which the suckering of corn is desirable?

3. Why is it that sweet and pop corn sucker more than dent corn?

4. Which is liable to sucker more, early or late planted corn? Why?

5. Which will sucker more, listed corn or corn planted shallow? Why?

6. Name four factors that influence the number of barren stalks in a field.

7. Name two good reasons why barren stalks should be eliminated from a corn field.

8. Is there any relation between the stand and the maturity of the ears?

9. Between the stand and barren stalks?

10. Between the height of the stalks and the brace roots?

11. Between the tassel development and the ear development?

12. Are twin-ear stalks to be desired? Why?

13. How would a dry period affect the ear development?

14. What are the most desirable points in a stalk of corn?

15. What is a good stalk of corn?

These are questions which should have been suggested by the present study. They are for thought. The student should thoroughly discuss them with himself until he is sure that he has an answer that is reasonable.

The object in bringing in these questions is to encourage the student to think for himself. Do not try to hedge around that thing for the most returns in all walks of life come to those who are capable of thinking for themselves. That does not mean the same thing as "having a mind of your own." This latter sometimes means nothing but stubbornness. But the man who is independent in

thought always has some good to look forward to, and many pleasures to look back at. Be the independent thinker. Take these questions and figure them out as you know corn from these studies. Some of the past pages may help you, but none of them will answer the questions directly. Do the work yourself.

COMMERCIAL USES OF CORN.

Before we go any farther there are three points that are necessary to complete this subject at hand. One of them is the commercial uses of corn. And the reason is that the market really sets the judge's standards.

The ordinary corn plant is needed for three of its parts: The ear, the cob, and the plant. These last two are of the least importance and so will be mentioned first.

The Cob Is Used.

Cobs are used for fuel. This practice is common especially in those sections where other fuel is difficult to get. And yet corn cobs do not make bad fuel. It is usually calculated that three tons of corn cobs equal in fuel value one ton of ordinary wood, but the fact that they are a by-product from the farm and elevators of the country makes them desirable.

Cobs are used as feed. Some ridicule used to follow an expression of the usefulness of corn cobs as feed. They are not of very much value, but when they are ground with the corn they add bulk. This saves the process of shelling the corn.

Cobs are used in manufacturing pipes. The section of the country that has prominence in this work is Missouri. There are parts around St. Louis where a special type of corn is grown for this purpose. It has an extremely large cob, while the kernels are shallow. The price paid for these cobs is about $25 per thousand pounds if the cobs are first class. The amount of these cobs produced each year is not increasing, since the supply in the United States is ample and there is little foreign output.

Cobs are used in upholstering, and for padding mattresses. That

is, there is a by-product from the manufacture of the pipes which is used for that purpose. It is the down which comes from the chaffing of the cobs.

The Plant Is Used.

There has been so much of corn stalks burned in the fields of the corn belt during the time that corn has been raised that the business men have wondered. In the business world a scheme of some sort would have been invented for the utilization of the stalk. And in fact from the commercial centers comes the need for the stalks.

Paper has been produced from rags and old paper for some time. This process was more or less expensive for the coarser grades of paper. So the corn stalk was tried and it has been found that a good grade of paper can be produced from the corn stalk for about $30 per ton. Paper from other sources ordinarily costs about double that. Specially devised machinery of course followed this discovery, until at the present time the work is a success. The leaves are not used in this process. The finer portions of the stalk are used for good paper while the coarser parts are used for cardboard.

The use to which the pith is put for packing on war vessels is often mentioned, but that is of little value outside of selected districts. It is being used, however, successfully for that purpose.

The cellulose, or coarse material of the corn stalk, is of value in many ways. Chemicals convert it into forms which are used commercially.

The leaves are used where they are the by-product of some of these other processes. They have been found fairly valuable. A number of the patent stock foods contain the corn leaves and other by-products in a finely ground condition.

The husks are used for the packing of horse collars and rough seats, and the like. Some forms of hats are made from the husks, but usually other products are more satisfactory for this purpose.

The Corn Is Used.

By corn we mean the kernels. And this is the part that is of the most importance to the average farmer, and is the part that sets the real market value of the corn as we ordinarily think of it.

Corn meal usually passes through our homes without the thought of the fact that it comes from the corn which we are raising on the farm. The corn meal industry demands good corn. The old methods of grinding took the entire kernel. But the modern methods where the product after it is ground must remain on the grocery shelf for no telling how long requires different tactics. It was soon found that if the germ were left in the corn meal it would deteriorate very quickly, while if it were removed before the product were ground and only the starchy part used it would keep indefinitely. So the germs were taken out and used for something else. There have been various methods, but the result has been all the same. There are special trades at the present time, however, where the whole corn meal is demanded. The people who buy this know that the meal will keep only a limited time. They also know that the meal is much richer for the presence of the germ than it would be without. For that reason they demand it.

Corn meal as a food will always be recognized. From the very earliest times it has been used. Many prefer it to wheat in producing bread. Its actual food value does not equal wheat, but it is not far below. Corn meal is sometimes used to adulterate wheat flour, but that cannot be recommended.

The by-products from the manufacture of corn meal are very valuable. These by-products may be classed under the germ-products and the hull-products. The oil is taken from the germ by pressure and the resulting "germ-oil meal" is sold for stock feed. This of course, takes place only in the larger concerns. The smaller mills take the germs and by mixing them with oats, or with the corn hulls produce a very satisfactory stock food.

Hominy is one common food which is produced only in limited sections for the reason that a special corn is required for the best hominy. If a community decides to raise hominy corn it will likely be profitable for all, but the single farmer in such an industry may be a loser. The corn necessary for good hominy should have hard, flinty, long kernels, the larger the better. White corn is the only kind used, for the market demands a white product. Some of the hominy products have the germ in them. Those are the common ones. There are some products that require that the germ be removed, but these are little known.

By-Products.

It would be very detailed to go over the various products in anything like complete fashion, but some of them can be mentioned. Oil cake and meal, that we have mentioned, is frequently used. Several forms of starch come from the kernel, the ordinary "Corn Starch" being the most common. Then from this comes several forms of sugars. "Karo Corn Syrup" is one. Corn rubber is a product often displayed but little is said as to its source, for the process is a secret one. Gluten meal, one of the valuable products, is used extensively where a concentrated feed is demanded. The protein of the kernel is what furnishes this product. Corn is likewise used quite extensively in the production of alcohol and alcoholic beverages. For this work a corn with a high per cent. of starch is demanded, for the reason that it is the starch that is converted into alcohol. The protein is of little use, except as it may be used in the feeds which are products resulting from the manufacture of the alcohol.

It can be seen from this that the standard used by the average judge is not that of any of these special industries. There are often classes made for hominy corn, and of course then it becomes the part of the judge to discriminate along those lines. But the usual standard is that set by the market which has to take all of these factors into consideration. All of these industries demand clean wholesome corn. Consequently the market demands it. And yet there is car load after car load of corn going to the market which will show 19 or 20 per cent. of moisture upon test. That means that the corn has not been mature. Or in other words the farmer was trying to raise a bigger corn than his climate would allow. Even the feeding of the corn demands a mature corn.

The market, and we usually think of the Chicago market as the one that sets the standard for corn, has to act as the balance wheel for all of the forces, those from the farm and those from all of the manufacturing centers. They think little about the cob and the plant for the reason that there is no demand for them. And so the farmer hears about that only indirectly. But the markets for shelled corn appear in the paper every day.

What Are Markets?

It would pay every one who has not already done so to visit the Chicago market and see how the work is carried on at that great center for human products.

Chicago is what may be called a terminal market. There are two kinds of markets: Primary and terminal. The first is that which takes grain from the farmer. The last receives the grain in large shipments for storage or for use where the demand exists. Chicago is, of course, both, but the larger work, as a city, is that of handling grain from a great many centers. To Chicago is sent the grain from thousands of local points where elevators have collected it. These elevators are of two kinds, the Line elevator, and the Co-operative elevator. The independent elevator might be mentioned, but there are few of those compared with the others. The line elevator is controlled by a company which has many elevators along a certain railway system. The co-operative elevator is owned by farmers for their own benefit. Both are successful where they are managed correctly, but the difficulty of getting good managers is greater for the co-operative concerns than it is for the others.

The corn is shelled before it is sent to the terminal points. Sometimes corn is shipped on the cob, but very seldom. It is loaded into cars that have been properly prepared. There are many points to be noted in arranging the car so that no leaks will occur, but definite directions cannot be given for all cars. If it is remembered that the corn is to go a long distance and that the weight on the car is very great there will be no slackness in using every precaution for safety.

The inspection which takes place just as the car enters the yards is where the eye of the judge is needed. Specially trained men do this work. In the Chicago yards there are several inspectors who spend their entire time grading corn for the market under the supervision of a chief inspector.

The car is opened. A record of the seal on it is taken, the number of the car, the date it arrived, and the like, so that should any question arise there will be no doubt as to what car is being discussed, nor as to any point in regard to the history of that car. A sample of the corn is taken by a long sampling device called a

"Tryer." The corn is carefully noted and details placed on the record book. A sample is taken to the laboratories for closer inspection. There, if the demand is made for a moisture determination, that is done. It takes about thirty minutes to run the determination, so the party, who is waiting to learn whether it will be profitable to

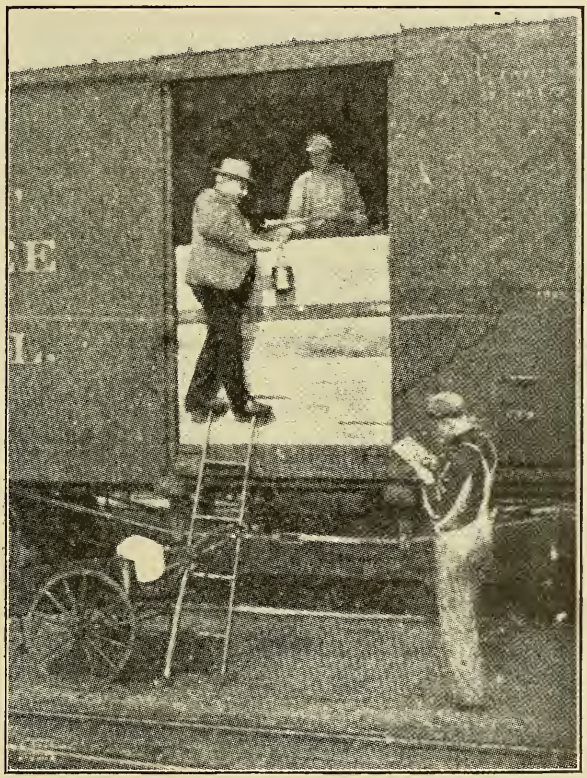

PLATE 14.—All cars of grain are inspected as they enter the terminal market. The weight of the grain is taken by the inspector. All points of the car are noted. There is little chance of having poor corn on the bottom without it being detected, for the inspectors take samples from all depths and from all widths of the car. After a grade is placed on the grain a sample is sent to the laboratories for further inspection.

buy or not, does not have to wait any great length of time. Corn ought not to show over 15 per cent. of moisture. If it does the grade is at once lowered.

There are many crooks and turns to the marketing question

that every farmer ought to know. There are many markets and the best one for one farmer may not be the best for another. But a study of the proposition is demanded. For our work in this case the part that is of the most importance is the grading.

From Judging to Grading.

The work of judging is a leader to that of grading. With the small grains the grading might be said to be the climax of judging. This is not so strictly true with corn for several reasons, one of which is that corn is sold on the market in the shelled state, and of course is graded in that condition. Corn is judged on the cob. The best way to learn what the grades really are is to visit the markets and the yards, see the inspecting done and the samples taken. The next best thing is to study the rules that these men lay down for their work. Following is a list of the grades of the Chicago market:

The following maximum limits shall govern all inspection and grading of corn:

Grade.	Percentage of moisture.	Percentage cob-rotten. Exclusive of bin burnt or mahogany corn.	Percentage dirt and broken grain
1	15	1	1
2	16	5	2
3	19	10	4
4	22	See No. 4, corn rule, all colors.	

No. 1 WHITE CORN—Shall be 99 per cent. white, sweet and well matured.

No. 2 WHITE CORN—Shall be 98 per cent. white and sweet.

No. 3 WHITE CORN—Shall be 98 per cent. white and sweet.

No. 4 WHITE CORN—Shall be 98 per cent. white, but shall include damp, damaged or musty corn.

No. 1 YELLOW CORN—Shall be 99 per cent. yellow, sweet and well matured.

No. 2 YELLOW CORN—Shall be 95 per cent. yellow and sweet.

No. 3 YELLOW CORN—Shall be 95 per cent. yellow and sweet.

No. 4 YELLOW CORN—Shall be 95 per cent. yellow, but shall include damp, damaged or musty corn.

No. 1 MIXED CORN—Shall be corn of various colors, sweet and well matured.

No. 2 MIXED CORN—Shall be corn of various colors and sweet.

No. 3 MIXED CORN—Shall be corn of various colors and sweet.

No. 4 MIXED CORN—Shall be corn of various colors; but shall include damp, damaged or musty corn.

SUMMARY AND CONCLUSION.

This work started with the thought that judging was an end in itself. At least there are those who, before they read these pages thought that. If you did not, you may compliment yourself. Judging of corn or of live stock will never be of any value unless that is applied where it is needed. For the most of us that will be on the farm. That is where it is required most for corn, and I believe that we are safe in saying for cattle and for hogs, for horses and for mules. But we are influenced by the markets, and on those markets the ability to judge corn correctly does not come amiss. Perhaps the live stock raised and the corn produced have told the markets what they should demand, but the markets are talking now, and we should listen.

Study the corn. There is a never ending story in it. And perhaps some day you will see profits coming to you in many ways because you knew some facts that others failed to grasp.

EXAMINATION

NOTE TO STUDENTS.—These questions are to be answered independently. Never consult the text after beginning your examination. Use thin white paper about 6x9 inches for the examination. Number the answers the same as the questions, but never repeat the question. Mail answers promptly when completed.

QUESTIONS.

1. What is meant by "judging corn"?
2. Is there any difference between that and "scoring corn"?
3. How do the ideas on corn judging at the present time differ from those of several years ago?
4. Where do the standards set by the judges come from?
5. What is a corn show? What should it be?
6. Wherein does the value of judging lie as far as the judge is concerned?
7. What similarities are there between the judging of animals and that of corn?
8. What is the value of the score card?
9. What four points are to be considered in scoring corn? The four main points.

10. What are classes of corn in a show?

11. Explain what is meant by each of the main heads under which the scoring is done.

12 What relation does maturity have to size of ear?

13. Is the filling of the butts and the tips important? Why or why not?

14. How should the ear be handled in order that every point may be seen?

15. How is the best method of arranging the sample for study or for show? Explain in detail.

16. Where in the history of the ear of corn as it develops and is disposed of is the matter of maturity of the most importance? Explain your answer.

17. What value has the kernel in indicating to the judge what the ear is worth?

18. Name four things that will indicate that an ear is immature.

19. Does it matter whether an ear will grow or not when it is sent to the show? Explain.

20. How can a germinable ear be told? Give details.

21. What is the germ? The chit? The embryo? The endosperm?

22. What are the indications of good breeding in an ear of corn?

23. Describe a good ear of corn, mentioning only the most important points.

24. What is a corn variety? Where does the judge meet varieties?

25. Will judging corn in Maine be the same as judging corn in Indiana? Why or why not?

26. What form of a score card is used where there is a large show and the people desire to have the samples scored?

27. How ought a judge to work in getting a show taken care of quickly? Explain the method of procedure.

28. What points in preparing for a show will assure a success?

29. What points will help in the work of the judge?

30. What is meant by "placing corn"?

31. Imagine three ears of corn. Give your reasons for placing one over the others.

32. What part does the plant play in the production of a good ear of corn? Cite an instance from the work that you have done.

33. What qualities should the stalk of corn possess?

34. Does it matter whether there are large leaves or not?

35. Of what use is the tassel to the plant? Can you see any reason for its shape?

36. Name five points to be noted in a field study of corn.

37. What are twin-ear stalks? Are they desirable?

38. What are suckers? Do they produce good ears?

39. For what is the corn plant used commercially?

40. In making corn meal, what part of the kernel is the most important?

41. How is grain sent to the terminal market?

42. What is a terminal market?

43. Explain how a car of corn is inspected.

44. Name five Chicago Board of Trade grades for corn.

45. More fully explain the relation between the markets and the judging of corn.

WRITE THIS AT THE END OF YOUR EXAMINATION.

I hereby certify that the above questions were answered entirely by me.

Signed.....

Address.....

.....

The Correspondence College of Agriculture

CORN—PART FOUR

THE

Correspondence College *of* Agriculture

FORT WAYNE, INDIANA

CORN—Part IV.

Corn Culture

By HARRY B. POTTER, B. S.
"Farm and Fireside"
Springfield, Ohio

This is the Last of a Series of Four Books giving a Complete Course of Instruction on Corn

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The CORRESPONDENCE COLLEGE OF AGRICULTURE

NOTE TO STUDENTS

In order to derive the utmost possible benefit from this paper, you must thoroughly master the text. While it is not intended that you commit the exact words of the text to memory, still there is nothing contained in the text which is not *absolutely essential* for the intelligent corn grower to know. For your own good never refer to the examination questions until you have finished your study of the text. By following this plan, the examination paper will show what *you* have learned from the text.

Part IV.—CORN

INTRODUCTION.

Before this last study is begun it may be well to outline it in a general way. The preceding studies have each been upon one subject and only one. This study has four headings to present. They are:

1. Diseases of Corn.
2. Insect Pests of Corn.
3. Breeding of Corn.
4. Some practical uses of the crop on the farm.

With the exception of the last point all of these have the yield of corn in mind. The fourth aims at the utilization of the crop in a practical manner. By far the largest of these subjects is the third for if the blood lines of the corn crop are neglected there will be little or no yield. And there is the interrelation of the first two subjects and the third, for in this day we know that some crops of corn are resistant to certain diseases. This sort is in contrast to that which is subject to all diseases. An investigation has shown that a great deal of a corn crop's ability to resist diseases and insects is due to the blood lines of the parents. Then it is not infrequent to find diseases entering where insects have already been. So there are interrelations existing between all of these subjects and instead of four as we thought we were going to have there is but the one: Corn. But that is a big one. We are splitting it as best we can for the purpose of study.

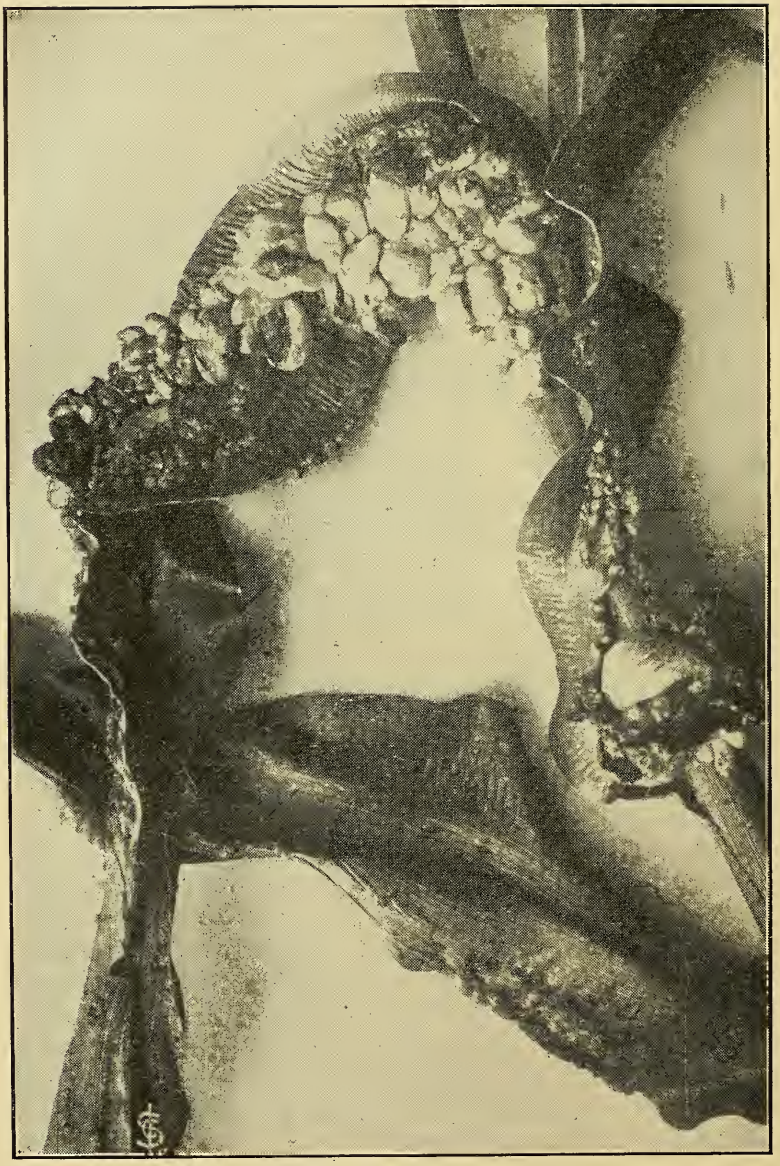

PLATE 1.—Smut on Corn.

DISEASES OF CORN.

Smut.

Corn Smut is known by the scientists, who have been trying for a good many years to find a remedy for this and other diseases of plants, as *Ustilago zeae*. We are not interested in this name except that it places the corn smut in a group that is worth noticing, the fungus diseases.

Fungus diseases are those forms of plant life which have no green coloring matter in them, which are extremely small, and live at the expense of economic plants. There are many of them. The rusts of small grains and of corn, the smuts of all of the grains and grasses, the moulds of many of the plants, some of the blights, and a lot of other diseases are due to these colorless plants which would not be able to exist were it not for the nourishment they receive from the plants on which they are living. Corn smut is one of the most common of these fungus diseases.

It is common, and as a result it is very familiar to every cultivator of the soil. For the ordinary years there is little loss due to this disease but some years the decrease may be over fifty per cent. This is not a large figure when one is speaking of some of the other cereals but with corn, or with any crop for that matter, the loss is too great to pass by without a thought. In the United States it would represent several millions of dollars annually. The prevalence of the disease is due to a large extent on the season, but the soil will also influence it. Good corn soil will usually show more smut on the crop than poor soil.

Smut may be found anywhere on the plant. It will affect the tender parts first, or the parts that have been injured. Fungus diseases are transmitted by what are known as spores. Spores are not the same as seeds but they accomplish much the same function. In most cases the spores are light and easily blown about by the wind. That is true with the corn smut spores. To start with the spores as they are produced on the plant, it is noticed, if the development is carefully followed, that these spore masses find lodgment in wet ground, or in a manure pile somewhere and there they remain until they are furnished the proper conditions for development, which are mainly heat and moisture. As soon as the proper conditions are supplied more spores are made by the growth of the fungus and

these are blown about by the winds to the corn plant where an opportunity is offered for their further growth. Here they are usually found in masses on the joints or on the ears. The reason that the joint is so frequently infected is that the tender growing part is at that place. It is the weakest.

When the plant is first affected, on the leaf or stem will appear white or brownish spots. These soon develop into much larger portions in which are numerous spores. The disease is entirely local. That is it will not spread from one part of the plant to the other. But it grows rapidly on the new and tender parts of the plant upon which it is feeding. The mycelium of the fungus plants, which corresponds to the stems and branches of a tree, spread in all directions through the tissue of the corn plant and develop new spores which find their way to manure piles for redevelopment and will remain inactive until such time as the weather makes possible the maximum growth of corn. Such weather means growth of smut as well. In three weeks time there will likely be, under favorable circumstances, a complete cycle. The corn smut will have been in the ground because it was plowed under only a slight distance, or because nearby was a manure heap. Spores will be blown from such places to the corn plant, and there the weaker parts will develop into the black masses so common throughout the corn belt. These spores in turn will be deposited in the soil or the manure heap to go through the same process just as often as the weather will permit.

The question arises: Are these smutted stalks and ears of any value as food for the animals for which corn was intended? There has been a great deal of work done along that line. The following table will give the relative value from the chemical standpoint of the corn smut, corn stalk, and corn fodder:

	Water	Protein	Fat	Starches	Fiber	Ash
Corn Smut	8.3	13.1	1.4	29.6	24.7	22.5
Corn	10.9	10.5	5.4	69.6	2.1	1.5
Corn Stalk	68.4	1.9	.5	17.0	11.0	1.2
Corn Fodder	42.2	4.5	1.6	34.7	14.3	2.7

This shows what the smut may be expected to contain, but it does not show what its real feeding value is. That has been the difficult matter before the scientists, and there is no definite state-

ment from them yet. Myrick in his Book of Corn makes the following statement:

Experimental evidence goes to show that danger from eating corn smut is very slight, if indeed, there is any at all, and that the harm may be more reasonably referred to other causes. In 1784 the distinguished French investigator, Imhof, experimented upon himself by taking a considerable quantity of the spores before breakfast every morning for a fortnight, also applying the spores to a wound on the hand and employing them as snuff, without experiencing the slightest harm or ill effects. Other early experimentalists and many recent ones have tried experiments both on man and animals, and with one or two exceptions no injury resulted. In these trials cows, which are thought to be the chief sufferers, have been fed on smut for weeks, often as much as ten pounds or half a bushel daily during the latter part of the time, without showing symptoms of injury in any particular, and with every appearance of being well fed on an acceptable and nutritious food. Some of the cows were pregnant.

Chemical tests, and physiological studies with fluid extract of smut however, appear to show that it contains small quantities of a narcotic substance, which taken in concentrated form may act upon the nerve center and affect certain reflex movements, especially those of respiration. It appears possible to cause death with it, but unless that happens the effects of even large doses soon disappear and no harm follows. That it is ever possible for an animal to eat enough of the smut as found in the field to produce death seems highly improbable, unless in the possible rare cases of a very susceptible individual.

There are two ways smut will reduce the profits from the crop, and so whether it will affect the animals or not the fact that it saps the vitality from the young part of the plant on which it is growing, and the fact that smut spores will take up the place designed for an ear and thus make the stalk barren, is sufficient reason for attempting a remedy.

Prevention is better than cure. If careless work about the farm has left this disease in the old manure or in damp ground, and the season happens to be cloudy and damp with a few winds blowing there is nothing to prevent the disease being very widespread.

Smut cannot be prevented, however, by the same treatment that will cure the smut of small grains. The reason is plain. The seat of the disease is not affected by the formalin which will kill the smut of oats. Let us follow the diseases through. Oats is affected by a smut spore falling on the grain before it is planted. Now bear in mind that this is an entirely different kind of smut from the corn smut and both these are different from that found on other cereals. In other words each grain or grass has a smut of its own which will not affect any other of the grains or grasses. Oats and wheat are cured of smut by the use of what is known as the formalin treatment. But to follow the spore after it lodges on the grain of oat: As soon as the seed begins to germinate the spore begins to grow too, and it grows up through the center of the fresh and growing stem of the plant, keeping pace with the plant to the end. As soon as the plant begins to head out the smut plant begins to develop spores in the same place that the plant desires to develop kernels and by this procedure the yield of the cereal is greatly reduced. Now if it were possible to stop the spore before it begins to grow up through the stem of the plant the cure would be effected. And that is just what the formalin treatment does when it stops the spore from developing by killing it as it lies in the folds of the grain.

But in the case of corn the cure must be something entirely different for the reason that the corn smut does not spread by developing up through the center of the plant. It attacks the plant from the outside. The only method that will get rid of the corn smut, then, is that which will get rid of the spores before they reach the growing corn. If the spores can be hindered in developing, the work will be accomplished. And so the advice is usually given to do away with the manure heaps and the low places on the farm where these spores which attack the corn plant develop so rapidly. If the disease is very bad, cut stalks which are affected, from the field and burn them. Prevent rather than cure. But do not try the scheme of soaking the corn grains in formalin. It won't work.

Rust.

Rust is a disease that distinctly reduces the yield of all of the small grains, but its effect upon the yield of corn is not marked. It is distinguished by small spots on the leaves, often reddish in color.

These spots are caused by spores; so that is another of the fungus diseases. It grows most rapidly in the humid sections, but there is little damage from it anywhere. Since it does so little harm there has never been a remedy suggested. It is also true that after many years of close work on the part of many scientists no cure for the rusts of the small grains has ever been discovered. It is not likely that the rust on corn will ever cause the same interest that the similar disease has with the small grains.

Other Diseases.

Other diseases affect the growth of the corn crop, but these are few and unimportant. Corn is disease free. But on the other hand there are many insects that are continually baffling the best thought of the country. A few of these will be the study for the next few pages.

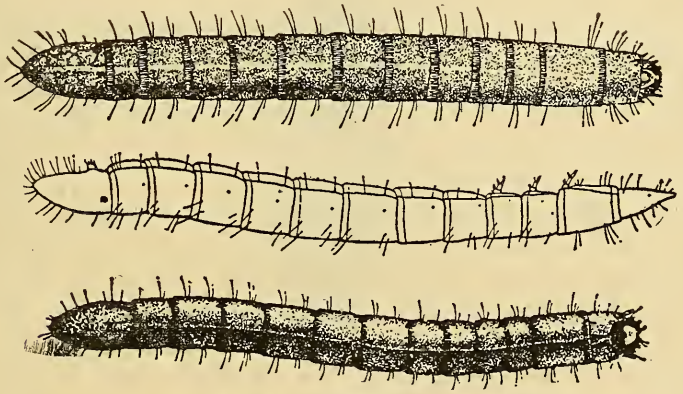

PLATE 2.—Forms of Wireworms.

INSECT ENEMIES OF CORN.

Wire Worms.

There is no insect which works as widely and does so much damage as the Wire Worm. It is the most common of all corn insects. Almost everyone knows what is affecting the fields when the corn either fails to come up or dies by turning yellow and withering.

The wire worm is reddish, with hard, smooth shiny back, cylindrical, and with six legs. When it affects the kernel it bur-

rows its head into the grain, and then eats all the way through the kernel, sometimes taking out the entire inside of the kernel. When the worms affect the plants they usually bore through the root parts of the stem and so destroy the feeding connections. They are common on ground that has been in grass for several years, and the second year after sod they are usually at their worst. The reason for this is the fact that the wire worm will remain in the ground two or more years before changing to the beetle form. The worms as long as the grass lasts have that to feed upon but when the corn comes and the grass goes completely, as it does, then corn is the plant that suffers. Of course the worm working in a large number of plants as is found in a grass field will not be noticed as readily as when it works in a corn field of scattering plants. And since each individual plant of corn means more financially than a grass plant, wire worms become of great interest.

There are several of these corn wire worms but they all resemble each other. There is little chance of mistaking any of the order for those of another. They will vary in length when full grown, from a half inch to an inch and a half, but the same slender body almost devoid of hairs, reddish in color, and divided into distinct segments characterize them all. Their life history is similar. They change into the dormant stage in July. In about four or five weeks they change into the beetle stage and are commonly known as the click beetles because of their habit of jumping into the air with a click when they are placed on their backs. Some of these beetle forms remain in the ground, others seek a hiding place. They lay their eggs in the spring, usually in sod ground. From this point on, the history of the insect is vague but the fact is plain that it develops into a form that does a great deal of damage to the crops of the average farm.

What the best remedy is is a question. There have been all sorts of poisons suggested, and many of them have been tried, but without success. Traps have been laid, but they failed. There seems to be only one effective way of meeting the average insect on the field of action and that is by systematic rotation of crops. One writer suggests that if there were interposed between the grass and the corn a crop that was not susceptible to the insect the problem would be solved. But that is easy to say. There are few economic crops

that will resist all attempts of the insects. One writer (Myrick) in commenting on this says:

"Even a clean fallow for an entire season will not starve out the worms, and neither buckwheat, mustard, nor rape crops, frequently recommended to clear the earth of wire worms, will accomplish the desired results. Salt applied at the rate of 1,600 pounds per acre, a heavy dressing, neither drives the wire worms deeper into the soil nor causes them to migrate to any appreciable distance. Kainit used as a fertilizer in very large quantities has little effect if any on the worms. The same may be said of Muriate of Potash and cloride of lime. Gas lime is capable of destroying the worms but has to be

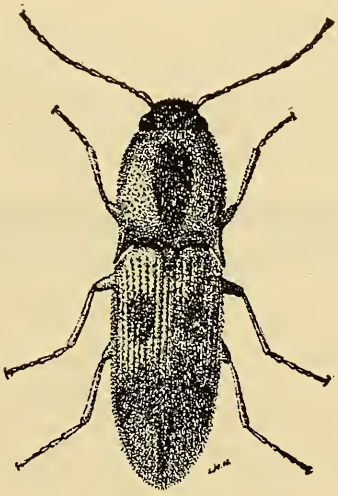

PLATE 3.—Parent of Wireworm.

applied in such large quantities as to be impracticable on large areas. The most promising method for relief is crop rotation, in which clover follows grass and is itself followed by corn. According to this plan pastures and meadows of grass might lie unchanged for several years, being plowed when broken up in late summer or early fall and sown to clover in the spring, either with oats or on winter wheat or rye sown the fall before. The clover should be allowed to stand the second year and might be followed with corn, with positive assurance that the wire worms originally in the sod would by that time have entirely disappeared."

Root Worms.

Now comes this seeming repetition that next to poor seed, the corn root worm is the greatest known source of loss to the corn crop. This seems like a radical statement and yet in the corn producing sections where rotations are followed with fair consistency this is probably true. One thing about this insect is that it is not confined to any particular section, but works with great force and loss wherever corn is raised. A test was conducted in 1905 through the states of Iowa, Illinois, and Missouri. Five hundred representative farms were examined to detect any work of the root worm in the corn fields. Over three hundred farms showed more or less damage from this insect.

The reason why more people do not realize the damage that is coming to their crops every year from the root worms is because the work of the insect is underground and because the pest is very small. The eggs are laid the first part of September, or the last part

PLATE 4.—Southern Corn Root Worm Larva (Enlarged).

of August in some places, and remain dormant until the next spring, June or July, when they develop into full form. When fully developed the insect is about one-third of an inch in length, and no larger around than a pin. The worms as soon as they are hatched begin to bore back and forth in the roots of the corn plant just under the outside covering. Sometimes only one worm will be found in a root, but often there will be as high as six or seven worms to the root. The effect of this work is plain. The roots drop off until there remains nothing but stubs, and of course these do not offer sufficient nourishment for the growing plant, and it is dwarfed. When a high wind or heavy rain comes the corn is easily beaten to the ground, where it remains; for the strength in the plant roots is not sufficient to raise it.

Along in August the worm reaches its complete development when it becomes a small beetle, which turns from the light color it first bears to a deep green color. This beetle feeds on injured parts

of the corn plant, being able, of course, to distribute its evil to many places. It is noticed that the worm is found most where the rotation has been neglected, and especially on those fields where corn has been raised continuously for several years.

It is not difficult to detect this root worm in the field. In the first place the corn will show a stunted growth just during the season when it should be growing the best. Then if the roots are broken open the worms will be easily noted. Even before the roots are broken they present a darkened appearance. Then even if the corn has come along alright up to the heavy storms, the fact that it lodges badly would indicate that the roots may be affected. The

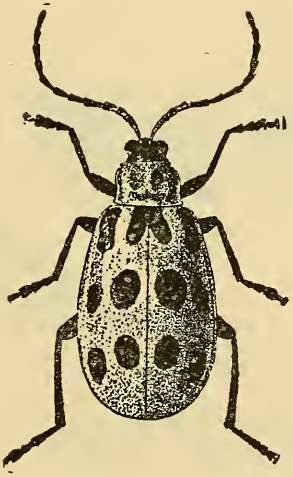

PLATE 5.—Southern Corn Root Worm (Enlarged).

corn may be easily pulled, or it may fire easily, or beetles of a deep green color may be seen during August, or some peculiar cases of late maturity may be seen and all due to the bugs.

Clover is the best remedy. How hard it is for some farmers to grow that crop. But that is what the land needs. Do not grow corn more than two years in succession on a piece of land. Seed it down to clover, mixed perhaps with some other good grass and let the corn grow on the land where it is needed. Rotation of crops solves a lot of difficult problems on the farm where the soil is giving poor returns.

Cut Worms.

Cut worms are damaging the crop every year especially in certain sections. Those sections in particular are those where crimson clover or some similar crop is plowed under in the spring. This practice allows the worms to feast upon the green leaves under the ground until the corn is ready for the use of the insects and then the worms change their place of work. Cut worms are bad wherever the sod that has been plowed under has not been completely rotted, and so they are quite widely distributed over the country, although not so much so as some of the other insects.

The moths that are the parents of these worms are varied, for there are many species. The female, under ordinary conditions, lays

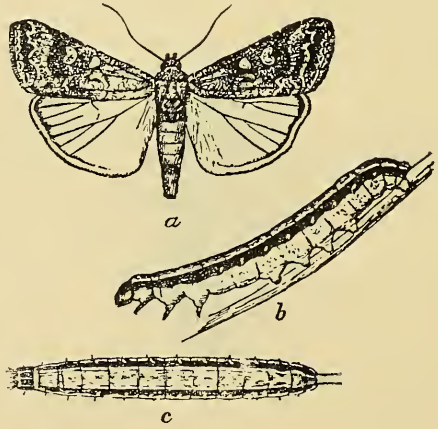

PLATE 6.—Adult Moth and Cutworm. *a*, Moth; *b*, Larva; *c*, Larva, top view.

her eggs in grass lands, but other places as the weedy road sides receive a due share. These eggs develop in the summer or late fall and the worms greedily feed upon any green vegetation that happens to be near by.

The lack of choice of food on the part of the worms makes many kinds of losses. Any sweet substance will attract them. Upon that fact is based the trap that is used. This is made of bran and molasses. The worms will eat bran alone but when molasses is added they will leave other material for it. So by poisoning this bran a great

many of the worms may be ridded out. But too often this is after the damage is done. And then to carry out this remedy on a large scale would be out of the question. The following directions are given only where the corn is of little acreage.

Wheat bran, fifty pounds; molasses, two quarts; paris green, one pound; and enough water to make a thick mash. The best manner for mixing this is to first mix thoroughly the paris green and the bran. Add the molasses after it has been diluted with some water. Stir thoroughly. Then add the water until the mixture is of the proper consistency. It ought to be like dough. In applying the remedy place a teaspoonful in a place, near each hill. Apply toward the evening. Of course where there is any area to cover, this cannot be followed. And the danger that accompanies this treatment is that some of the chickens or the turkeys, if they are where they can get at the bran and the poison, will be killed.

Care must be taken to prevent any undesirable deaths. If after the bran is applied the land is given a light cultivation there will be no further trouble. In most cases it is possible to keep the chickens out of the field a day or two.

Corn Root Aphis.

The Corn Root Aphis is another of the destructive insects of the corn crop. These insects are very small and so go unnoticed so often that the true extent of their damage is unknown. They are smaller than the point of a pencil, are blue green in color, and when they are noticed on the corn roots they are seen in clusters. They are always associated with ants, without which they would not be of much account and for which they are very beneficial. The ants convey them to the place where there is new food. Seemingly in return the lice permit the ants to use a sweetish substance which they exude from their bodies. The lice get their nourishment from the juices of the corn roots. They bore through the outside coverings of the roots and then suck on the sap.

The corn root louse is likewise found on land where there has been little system of rotation. It is strange that so many evils follow bad methods of farming. And yet it is not strange for all of the laws of nature work that way. The man who neglects the laws of

nature all the time stands a greater chance of some evil than the man who has been careful. The man who never steals is the man who does not get behind the prison bars. And so in agriculture there are punishments for the misdoings of us farmers. Whatsoever we sow, that we must reap. Take for example in the southern states where cotton has been king for so many years. What is the condition there? Why, the Cotton Boll Weevil is driving the people out of the country, and for the simple reason that the farming population did not rotate their crops. That is what is causing so many people to grow corn where cotton has been grown. That is why the ex-

PLATE 7.—The Corn Root Louse, Wingless Female (greatly enlarged); *a*, Tip of Abdomen (more enlarged).

periment stations are pleading for the people to produce pork. And once the people begin the production of pork the north will have a difficult time to compete, for the southern conditions are ideal for the forage crops, that added to the ration of corn, will produce hogs at a much cheaper gain than in the north. And all of whatever happens in the next twenty-five years will have been due to the insect which was caused by poor farming. The only remedy is to change the methods of farming. That is what the south is doing and that is what the north will have to do if such insect pests as the corn root louse is controlled.

There is another remedy that may help. It is rather a preventive measure. There are few cures for these pests after they are once bothering. That is to drain the land, and keep it free from weeds. The lice live on the corn as long as there is fresh tissue. But when the roots of the corn plant become a little tough these insects shift to whatever is handy. Too frequently weeds are handy. Then the lice remain there until another supply of plentiful corn is at hand. Low ground usually has more weeds than higher places, hence the benefit of drainage.

The lice may remain on the plant roots sometime, as was said, but they do very little damage late in the development of the corn

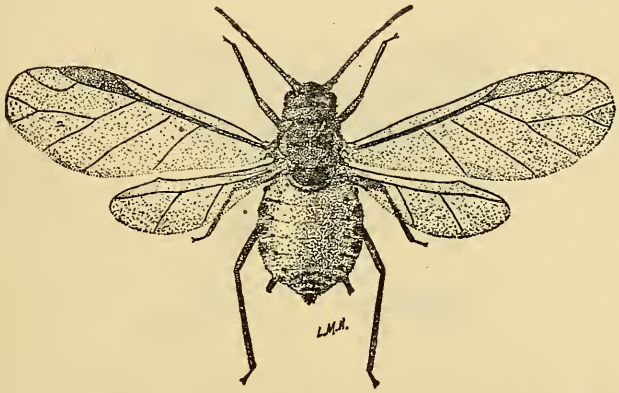

PLATE 8.—Corn Root Louse, Winged Female (greatly enlarged).

plant. It is during the early life of the plant that the lice do the damage that so reduces the yield. The dwarfing of the plants, especially in spots of the field here and there, and the change of color from green to a reddish yellow are good indications that the louse is at work. The presence of ants may well arouse suspicions. Lice later in the season will cause the crop to be later maturing than natural.

Professor Forbes, one of the greatest entomologists of the country who has done most of his work in Illinois, suggests a complete change of crops with the hope that the corn, when it is planted on land where other crops have been grown for some time, will have very little if any bother from this pest. Clean cultivation in the low

places will help some. Fertilizers are sometimes applied directly to the hills affected or to all hills with the expectation that the resulting plants will be more nearly able to withstand the attacks of the lice. If the ground is harrowed before the corn is up the weeds will be checked and with them the lice, and then besides the help from this source the ground will be immensely benefitted by the cultivation. The destruction of the ants during the late fall or early winter is thought to be of a great deal of benefit. The idea is to get rid of the ants by destroying their eggs by freezing, which can be accomplished if the hills are overthrown. It may be found worth while to hold off planting until late, but this has so many attendant evils

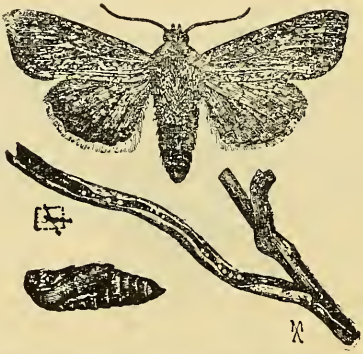

PLATE 9.– The Army Worm. Moth above, Pupa below and Eggs in natural position in a grass leaf—all natural size.

other than insect perils that such a practice could not be universally advised.

In other words, these insect pests are not easily removed, once they get a foothold.

Army Worm.

The Army Worm is prepared to develop rapidly. It too demands rapid work for its extermination. The female often lays as many as 600 eggs, and these may be found any where from the gable of a roof to the under side of a straw pile. The adult moth is brown in color, just slightly spotted. Naturally these insects thrive in the grass family, and it will be recalled that corn is a member of that large family. About eight days after the eggs are laid they are

hatched, and the young worms begin at once to feed. But they do not do so openly. They hide during the day, and so are not seen without a search. They move in armies and will sometimes devastate a whole field or section of the country. After attaining full size they go to the ground where they again become moths. More eggs are laid, more worms are developed, and more destruction takes place. There may be as high as three broods each year. Nature has provided a natural check for this pest in the form of another insect which lives on these worms while they are on the march. But the killing is not thorough enough in most cases, so man has devised the scheme of a trench where, as the worms arrive, they remain; for they cannot climb the rough ground. As soon as there are sufficient numbers in the trench they are killed by kerosene or some other poison.

The worm is easily told from others by its movement which corresponds to a measuring worm, and by a naked broad stripe on each side of the body for the entire length. If the worms are young there may be a slight variation, but not enough to deceive the spectator as to what the worm happens to be. Their work is that of stripping the plants of their foliage.

Corn Worms.

Just what this insect will be called depends upon the locality where it is being discussed. It is known as the Ear Worm, The Cotton Boll worm, the Tomato Worm, and the Tobacco Bud worm. It is more an insect of the south and yet all parts of the north have felt its power in destroying the yields of good marketable corn. The worm is a sort of a green in color, sometimes almost brown, with stripes of the same color running the length of the body. There are as many as five broods during a season in some of the southern states. The eggs that are first laid are placed on the leaves where, when they hatch, the worms begin to eat of the fresh green plant substance. But the brood that affects the ear is the one that has the eggs laid on the silks of the ears. As soon as the worms appear they begin to eat of the silks, working toward the ears. They work themselves in between the husks and the kernels and begin to eat the kernels themselves. Sometimes they are not after all of the kernels but just eat the best part and keep on circling the ear. When the

ear is opened the worm is bedded in the kernels. Very often these worms will be dead and rotted so that the corn is anything but marketable after it is husked. Some of the adults, however, take themselves to the ground where they prepare for another generation.

Sweet corn is more commonly affected than field corn. Yet the loss to field corn is considerable everywhere. Sweet corn is often used as a trap crop, from which the worms can be taken and burned before the other corn has been affected. Hand picking of the worms

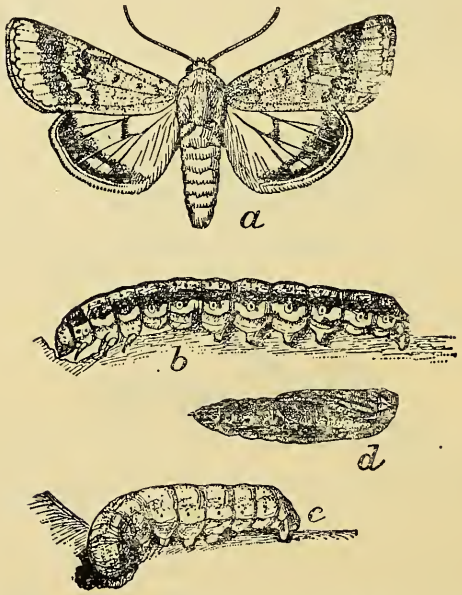

PLATE 10.—The Corn Worm (*Heliothis Armiger*). *a*, Adult Moth; *b*, Dark Full Grown Larva; *c*, Light Colored Full Grown Larva; *d*, Pupa—natural size.

is also practiced. And fall plowing will throw up the dormant forms of the insects and subject them to the action of the weather. Of course where corn follows corn only a limited amount of fall plowing can be practiced.

White Grub.

Everyone is familiar with the White Grub, although some of the other insects are little known. At least everyone is familiar with

the June Bug, or May Beetle, which is merely one of the stages of the White Grub. Corn is one of the crops which this pest attacks.

The adults, which are the June Bugs, are hatched from eggs that are laid in grass lands. They are really beetles, with their hard backs, and brown color which is very characteristic. As soon as the male and female pair, the males die and the females begin to lay their eggs, which operation is not completed until the latter part of June. These eggs are laid in the ground all the way from two to four inches deep. They hatch in about fifteen days.

The effect on the crop of corn may be great or little. Whole crops have been destroyed by this insect. The grubs begin to work as soon as the corn is ready for them. The fact that they work on the roots causes the crop to poorly withstand the dry weather condi-

PLATE 11.—White Grub, Young of the June Beetle (enlarged).

tions. For the grub may have destroyed the best parts of the root. It is easy to detect the work of this insect. The plants when they are pulled from the ground will show roots that are eaten away and no other insect works in just that manner. And then, if the ground around the affected portion be plowed or spaded, a lot of the grubs will likely be unearthed.

Since it is true that the eggs are most frequently laid in grass lands, the grubs are most frequently found where corn has followed sod. From the standpoint of avoiding this insect alone it would be much better to follow clover, small grain, or even corn itself than to use sod land. Clover is free from injury by this insect and so it is a good crop to insert between the grass and the corn. And then think of the nitrogen that the clover is bringing to the land. Professor Forbes advises turning hogs into the pasture after plowing it

for corn, but this is practical only where the ground is plowed before the first of October or later than the first of April, for the grub beetles are deep in the ground during the winter season and the hogs would never touch the spot otherwise. It is desirable, if the prevention of the egg laying in June is regarded, to keep the land free from weeds. Vegetation of any sort is an attraction to these beetles.

Clover is the best remedy. There seems to be no patent device. Fall plowing will sometimes help in getting rid of these pests, and kerosene if applied at the right time and in the right proportions will get rid of the grubs on a small scale but there is no medicine treatment for the large fields.

Chinch Bug.

And who has not heard of the Chinch Bug? No one. Probably because of the fact that the insect attacks crops in widely different localities.

There are no stated seasons when this insect will work. It seems to come and go like the locusts. But when it does attack the crop no mercy is shown. The plants will wilt from a loss of the sap from their veins, and the whole field will look deserted. While the other cereals are attacked, corn is liked as well as any of them and so suffers much from the Chinch Bug. As soon as the wheat crop has been cut the bugs will proceed to travel on foot to the nearest corn field. It is a common sight in the west to see whole droves of these bugs going to one place. The method for trapping them is to dig a trench with a plow. Make it about eight inches deep. Drag a log along the length so that a fine powder will be on the bottom of the furrow. The insects are unable to manage themselves in that dust and so are trapped. Other blockades are suggested, such as tar. The bugs will run up and down the tar strip but will not attempt to cross. Post holes, every so often, will furnish a trap. A great deal of care should be taken to have no rubbish or loose straw over the boundary strip. Methods of treating the individual hills have been tried with some degree of success. Kerosene emulsion is the best remedy where a drug is planned.

The method of prevention is to keep the rubbish away from the premises. Then there will be little chance for winter quarters.

The entire corn plant is affected when the chinch bug comes. These bugs are reddish brown with a light strip just across the back from side to side. The red color is common for the young bugs. As the bugs get older the color becomes more of the brown. Just the time when the corn begins to do well in the field is the time that the bug is beginning its depredations. The yield may be materially reduced; in fact it may be nothing at all.

Seed Corn Maggots.

There are two kinds of these legless individuals that affect the corn crop. The one with the shiny black head does so only after a grass crop, which is its main host. The other, apparently, has no

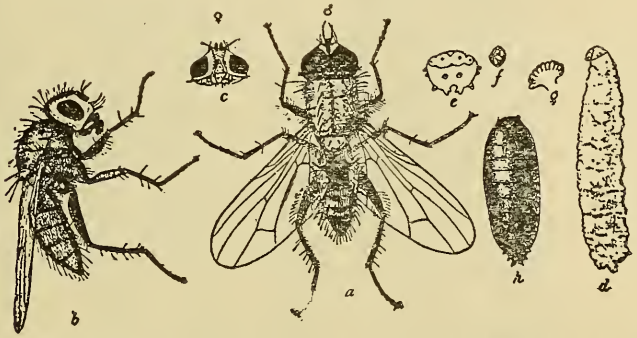

PLATE 12.—The Seed Corn Maggot (*Phorbia fresciceps*): *a*, Male Fly, dorsal view; *b*, Female, lateral view; *c*, Head of Female from above; *d*, Larva, from side; *e*, Anal Segment of Larva; *f*, Anal Spiracles; *g*, Thoracic Spiracles; *h*, Puparium—all much enlarged.

head and works on corn alone. Both work in exactly the same way. The kernel after it is placed in the ground becomes softened and the maggots enter. They eat out the entire inside, the mealy part, and then change into the next form in their life history.

In this study of insects it is being taken for granted that the student understands the general principles of insect life. There are no classes of animal life that develop in the same way. In general it may be said that there is one stage in insect life where the animal is dormant, does not have the power to move; another stage where wings are noticed, it usually is able to fly; another stage is that of the worm, having the ability to move by crawling. Any of these

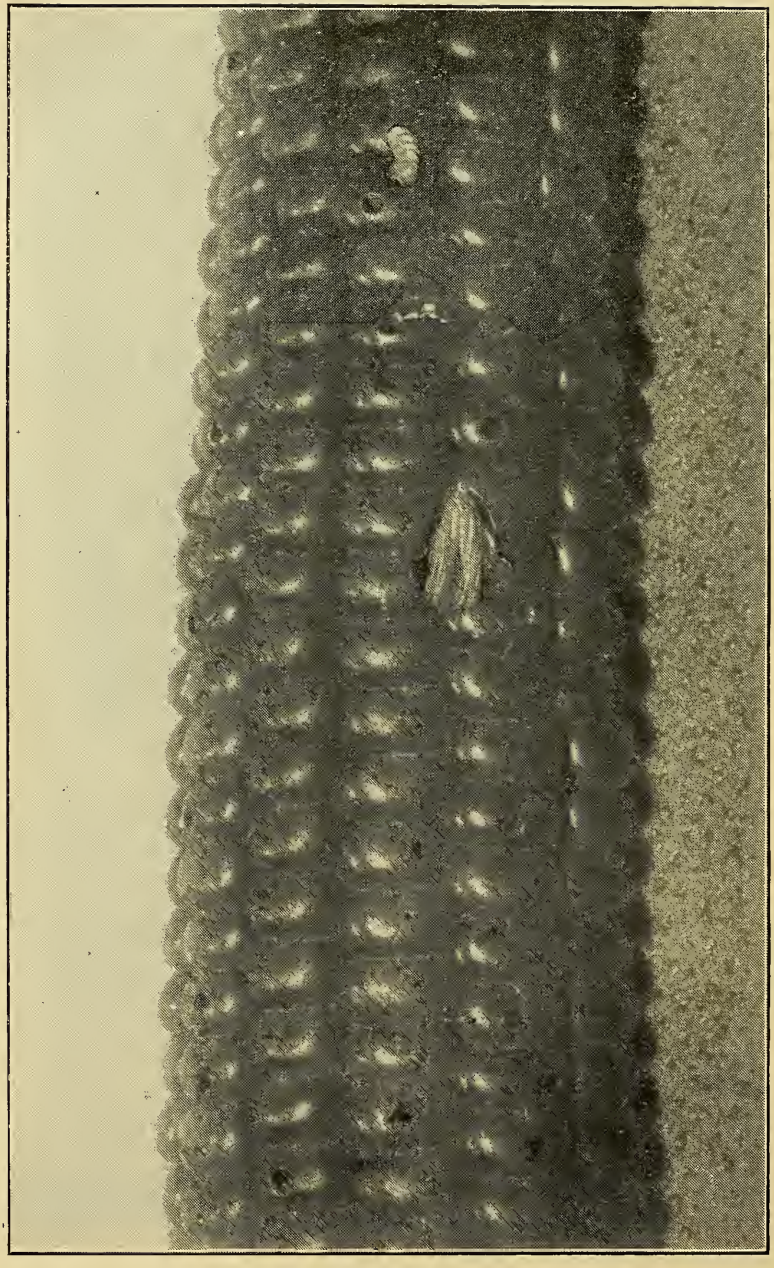

PLATE 13.—The Angoumois Grain Moth and its Work.

active stages may be the destructive one, and some insects may not have all of these named stages. They may have more than has been named. The outline form that is here given applies to the most of the insects that affect corn.

And so we find these maggot forms, which might be called the worm stage, changing into other forms. The first named maggot changes into a two winged fly; the second changes into a small black gnat like a mosquito. With this insect only one brood, or transformation, occurs in one year. It will be remembered that the corn worm and some of the others may have several broods during one season.

The most favorable season for the action of these maggots is that in which there is a great deal of rain. The action of the rain begins to rot or germinate the corn. The action of germination is nothing more than a form of rotting. Of course there is greater opportunity for the maggots to work in rotted or partly germinated corn and so they do well. Sometimes these maggots will affect only the kernels that do not grow, but if there is a scarcity they will affect anything, even the partly sprouted stuff. After they finish their work there is nothing left of the kernels but the outer hull, for they take out all of the real food.

Some fertilizers are said to kill these maggots. Likewise kerosene is recommended. An application is made with sand as the medium. That is the sand is thoroughly saturated with the kerosene and placed at the base of the plants just at the time when the adults would be laying the eggs. This it is claimed will kill the adults and will often prevent any of the maggots from working in case they have already hatched out. When the maggots have become apparent in the field the best plan is to pull the infested plants and destroy them. This system works very successfully with many of the other root eating insects.

Grain Moth.

The Angoumois Grain Moth is one of the most destructive insects affecting the stored grain and it works mainly where there is a great deal of wheat in storage. In fact the wheat and the corn kernels are the main ones that are affected with it. The ear of corn looks, after the insect has been working, as if there had been a lot

of little nail holes made in each kernel. At a distance it seems to have been spotted with round black dots but a closer inspection will show these dots to be holes in the kernels.

The moths lay their eggs in between the kernels on the ear, usually after it has been placed in storage. The eggs develop into the worms which enter the kernels at the tips. These worms eat out the heart of the kernels and then go toward the crown where they become dormant. From this stage the adult moth emerges near the crown leaving the holes which give that characteristic appearance to the ears. All of this has happened in about six weeks but if the weather has been warm even that short period may have been shortened.

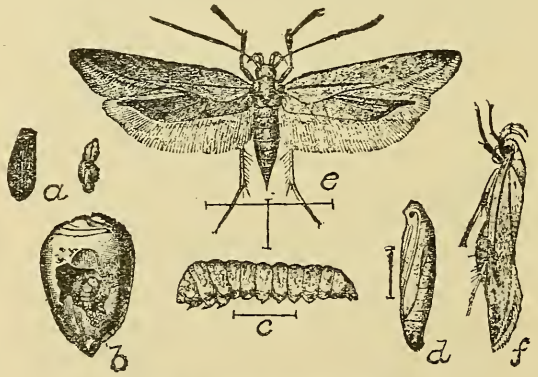

PLATE 14.—Angoumois Grain Moth.

The best way to cure or get rid of these moths is to use Carbon Bisulphide. The bin or the place where the corn is in storage should be made air tight; then the Carbon Bisulphide may be placed inside. The gases will do the work. Care should be taken to keep matches away from the gas. Grain that has been fumigated with this gas may be used for food at any time. It might be added that in the treatment there is no need for placing the bisulphide where it is lower than the grain for the gases are heavier than the air and will reach the lowest recesses anyway. It may be necessary to fumigate several times since moths will be coming out from time to time.

Weevils.

Another enemy to the stored grain is the class known as weevils. There are several. All of them work in much the same way. The common sort of beetle of this class is about one-seventh of an inch long, and is of a brownish color. By means of a long beak or snout this beetle punctures the kernel and lays an egg in the hole. In a short time the eggs are hatched and the worm form appears. It is a white, legless form. The time that is required for the brood to develop is so short that several may come in a season. The southern states seem to be affected more than the northern states.

There is but one remedy and but one preventative measure for this insect: Carbon bisulphide and cleanliness. The latter should exist in all places where corn is stored. After the enemies appear then the bisulphide may be used to advantage. Cribs and bins should be made air tight before the bisulphide is used. This may be done by using blankets and robes.

Summary of Insects.

It will be seen that the insects studied come under three classes: Those that affect the plant, the stored grain, and the milled grain.

In all of these classes cleanliness of the surroundings has been a preventative measure. The man who keeps his meal bins clean is less likely to be bothered by the insects that work in corn meal than the man who is not careful. The stored ear corn will become infested where the conditions are not sanitary and wholesome. And the field corn will be attacked where the ground has not been kept clean by rotation, drainage, and cultivation. So cleanliness means much towards having good corn for the market.

All in all there are about three hundred insects that attack the various parts of the corn plant and its products. That does not mean that that number completes the list. There are others but those three hundred are frequently found. The most dangerous are those that attack the young plants usually underground. Any of them will cause loss enough, and so it behooves every worker in this industry to prevent and kill whenever and wherever possible.

PLATE 15.—In breeding for all of the good qualities in corn, the field is the place to do the studying. Look at the ear, the plant, the conditions under which it has grown. Know the seed that is to be used.

THE BREEDING OF CORN.

What is Breeding?

What the subject of breeding includes has been a matter of question for many years among those men who have been working with plants and there is no definition that will hold at this time. Some man will write a book upon the subject and will treat some themes that are entirely foreign to those that are treated by another author.

It is generally understood that breeding animals means more than merely mating the males and the females. It means improvement at the same time. And so with the plants, and with corn which is one of the chiefest of our plants, breeding means that the crop is to be improved. And if the crop is to be improved in yield and quality its progeny must be guarded. And so we may say that

breeding of corn is the control of the progeny with the idea in mind of definite improvement in yield or quality or both.

The accomplishment of even the definition is not an easy task. For corn has peculiarities that set it out from all of the other farm crops.

The Nature of the Plant.

Plants may be fertilized by self, close or cross fertilization. Self fertilization is that condition where the pollen from one flower falls on the female or pistillate parts of the same flower. The breeding takes place within the flower itself, there being no outside influence. Close fertilization is that where the pollen from a nearby relative is used. It is the mating of relatives. Cross fertilization is that existing where the pollen from one plant falls on the female parts of a plant entirely distinct and separate from it.

Grasses are naturally cross fertilized. So we would expect corn to fall in that class. And it does. But the question is arising in the mind of someone as to wheat, oats and barley. These are all self fertilized to a large extent. And they are exceptions to the rule, although it is customary to think of the matter in just the reverse way. Corn fits the regular rule.

Now it means a great deal to remember, when breeding operations are being started, that corn is cross bred. And being cross bred there are some things that must be guarded. A single head or ear of wheat may be planted in a field. Each of its kernels produce heads like the one from which it came. But with corn the matter is different. An ear of corn placed in the field with other ears will receive pollen from many sources and so will reproduce in no stable type. That means that if the corn is to be accurately reproduced to a certain type it must be restricted and guarded; methods must be devised to overcome the effort of nature to cross fertilize. For corn is distinctly a cross fertilized plant.

Methods of Breeding.

In this study we will start at the simplest known form of breeding and work to that which is the most complicated. Be sure that every point is understood before you advance to the next.

Field Breeding

The ordinary field presents a type of breeding that is the most common. Someone may say that there is no breeding going on in the sense that there is no improvement, and perhaps that is right. But because of the fact that so many farmers depend wholly on this method for results, we will call it field breeding. There are a great many plants. Most of them are producing ears. Most of them are producing tassels from which will fall pollen that will fertilize some of the neighboring plants.

Now the most that most farmers do, who will not believe in the later and better methods, is to select from this field, that has been so indiscriminately mated, the corn that they desire for their fields the coming season. Sometimes that selection is made at the crib. If it is, there is little chance for improvement. Sometimes the seed ears are selected at the time of harvest from the stalks. That is better. Sometimes the corn is selected before the killing frosts come. That is still better, and all will aid in the field breeding that is going on whether the farmer realizes it or not. The last method, that of selecting the seed ears from the stalks as they are standing in the field and before the frosts come, will add several desirable features to the oncoming generations. Early maturity will be encouraged and this is especially important in the Northern States. But why will early maturity be encouraged if the ears are selected early in the fall season. Let us see.

Some Principles.

In the language of the animal breeder there is no term used more frequently than that "like will produce like." What is meant by that? In general it refers to heredity. It is known that when living matter is being reproduced there is something in the life of the matter that will stamp on the generation that is to come the likeness of itself. Children become like the parents because of the laws of heredity, and the fact that like produced like is one of the laws that becomes a part of the greater law.

Then, besides this, we speak of improvement by **selection.** It is usually conceded that no plant or animal life would be improved at all if it were not for the fact that selection takes place. This

may be natural as in the forest where the weak and smaller trees are crowded out for the larger forms, and so become extinct, or it may occur at the hand of man as when the corn plant is improved by the selection of the best ears or the best stalks. All, except those that are selected, are of no use whatever in producing qualities in the on-coming generations. Their blood lines are thrown away.

So, when the early corn is selected for seed the generations following tend to ripen as early as the parent plants. And so it is when any point is selected that point tends to reproduce itself in the offspring. And it has been found in the case of corn that physical characteristics are definitely controllable by selection in the proper way.

Now another thing that enters into the work. Individuality means everything. That is, selection depends on individuals, and improvement depends on selection. The individual for selection in the case of corn is the plant. Kernels cannot be chosen and from them great results secured for the reason that the kernel is but a part of the ear, and the ear only represents a part of the plant. Now I know what you are thinking. You are thinking of the uselessness of selecting the ear when it is the plant that has the unit characteristics back of its growth. And in a way you are right. You are exactly correct when we think of the crib method of selection, for that accomplishes very little real improvement at all. The best looking ear may have come from a stalk that was poor and, under most conditions, would have produced ears of no worth at all. But if the best looking ear is selected from the best looking stalk then success is assured. This may be said without qualifications.

In the study of the ear and the plant the various parts of the organism were considered as they would help to build up a high yielding corn. If those points are remembered in the selection of the corn from the field, improvement will follow in the shortest possible time.

Ear and plant are inseparable, then, but the ear is not the unit. The plant is. And in the field where the field breeding is going on there are all sorts of intermingling of bloods. That is good from the standpoint that corn is distinctly a cross-fertilized plant and unless it secures its pollen from some not near related plant it will be a

failure. But in the sense that unprofitable blood lines are being added it is not desirable. That is partly overcome by the next system.

The Breeding Block.

The Breeding Block has been in use for a great many years in one form or another. And as a result of its influences it has accomplished much good. It does nothing more or less than separate from the general run of corn that is used for the main field the corn that has been specially selected from the field the year before. What will that accomplish? The corn that has been selected will, by the laws of heredity, transmit to the offspring its characteristics. It has better characters than the other corn for it is known to have come from good stalks in the field and to possess good ear characters. If this sort of corn is put in a place apart from the rest the characteristics will be accumulated and better corn will follow. Such corn ought to possess the best characteristics of all of the selected ears. The cross breeding will not be neglected for a great many ears have been planted in this Breeding Block, and they will interchange their pollen to such an extent that the vigor of the plants will not be reduced.

With the ordinary field under ordinary conditions this Breeding Block may be put at the edge. That is, the best ears will be planted apart in some corner. Many of the corn belt farmers use the southwest corner for the reason that the prevailing winds are from that direction and will blow the good pollen from the good part of the field to the general field rather than the reverse. The Breeding Block may be of any size that is convenient. But it should be protected from foreign corn, for while some benefits result from the mixing of varieties there is no permanent improvement. It may be necessary, therefore, to take your good corn to the center of your general field. The corn there will at least be of the same variety, and if there is a fair-sized block of the good corn there will not be enough of the poor corn mixture to interfere with the inner parts of the block. This method is followed by many successful farmers. They take the very center of the field and see that their best corn gets planted there. After that there is no special care required since that corn may be cultivated along with the other corn. How-

ever, many are following the practice of hoeing the special parts of the field, but that is not necessary as far as the character of the ears is concerned, unless the field is exceptionally weedy.

The points that are essential to remember to this method are that it segregates the best ears in one place so that the best blood will be collected in the resulting generation, that no special care is needed except at the time of planting, that seed selected from a block of this kind is stronger and better able to perform well when planted than corn selected from the general field, and that this method is practicable for all farmers who raise corn.

Plot Breeding.

The term breeding is often falsely applied to the work of the experiment stations and those who are selling seed corn on an enormous scale. And when that is considered there is always in mind what we have chosen to call the plot method of breeding. It suggests more detail. However, the farmer, who is wide awake, can use some of its methods.

Ear-to-row Test.

Scarcely a person today but what has heard of the ear-to-row test. And that is probably for the reason that the test has been so successful. It is based on the fact that the plant is the unit. that there is usually but one ear to the plant and so that would represent the plant, and that if the ability of that ear and plant to yield corn is for once shown the advisability of using it for seed will be known. After a great deal of study and work it was discovered that the crossing of corn the first year did not affect the yield that year. It was known that if corn were planted anywhere near to other corn there would be a mixture. Then it was soon found out that it was impossible to get the strains far enough separated to prevent mixture. "But," said the workers, "is there any need in this preliminary test to get the corn separated? If the ears are planted in rows side by side and harvested separately the yielding ability of each will be known. And if a half of each ear has been saved the halves of the high yielding ones may be used for seed to produce higher yielders."

And that was exactly what was done and it worked. One-half of each ear was shelled. That half was planted in an individual row. Beside it was a row planted from another specially selected ear. Beside this row another, and so on, down until all of the ears were under test. At the close of the season the rows were harvested each by itself and the weights taken. The yield per acre was calculated. This told easily which ears were needed in the Breeding Block.

This method is but a modification or an adaptation of the tests put to live stock. Take one example, that of the dairy cow. In the modern dairy, what cow holds her place if she cannot produce milk and butter profitably? And in the corn field the question should be asked, "What ear and stalk is worthy of a place in this field?"

How this ear-to-row scheme may be applied to the farm should be worked out by each man for his own conditions. The experiment stations have a scheme for length of row which will give them the yield of the corn per acre directly. That is, there is no need of any figuring after the row is weighed up, for the figures on weight tell all of the story.

The Breeding Plot.

After these ears are known, as a result of the ear-to-row test, they are placed in a breeding block. The purpose of placing them in this block is to get seed of sufficient quantity for distribution. The idea is that if all of these good bloods are mixed a corn will be produced that will be extremely desirable for planting. And the idea works out in practice. Do not think that the amount of corn will be great the first year from the ear to row tests. The average that is saved from these tests where they are run every year is only ten per cent. of all the corn tested. It is this ten per cent. that is planted in the breeding plot.

The strongest ears are planted in the even numbered rows, and the next strongest ears in the alternate rows. This gives the greatest possible mixture of pollen. Then it is often desirable to detassel the stalks that are in the even rows in order to make sure that they are the female ears. The female ears always give the offspring the greatest impression of their qualities and since they are the best

ears the best characteristics are transmitted. The male ears, although they are fairly strong, give the least impression of their value to the offspring.

The Multiplying Plot.

After the breeding plot has produced crosses from the ears that had been tested in the ear-to-row test, the best selected ears are placed in the multiplying plot. That is, even at this point there is not enough seed for general distribution. Seed from the breeding plot must be increased in quantity. That is done in a field as nearly isolated from other fields as possible. The seed is planted in the ordinary way and grown just as any corn would be grown, except for the isolation.

It was mentioned that the ear-to-row tests did not need to be separated from the other corn, but the breeding rows should be. For from the time the seed has proven its worth it must be kept pure and to keep it pure every precaution must be used. So the breeding plot and the multiplying plot must be isolated in some way or another. Sometimes a woods or a hedge will accomplish the work, but it is best to have the corn far away from all other corn if possible, whether there happens to be a wind break near or not.

Strange Ideas.

An idea prevails in some sections as to the value of mixing corn. That is, the mixing of varieties. Men have presented their corn to the judge with much disgust because it was not given first prize, and they were much more disgusted when they heard his reply that the ears showed a mixture of other kinds of corn. Their idea was that the more mixing the better. This point has already been mentioned, but let me repeat it here. It is not desirable to mix varieties of corn any more than it is best to cross breeds of live stock indiscriminately. With corn there seems to be a sudden increased yielding power the first year after the cross, but from that time there are no high yields at all. In fact, the reverse is true.

Then there has been so much said about the need for detasseling corn in the field. Ideas have gone the round that that would increase the yielding power of the stalks detasseled. Experiments

PLATE 16.—The way to detassel the plants. Do not use a knife.

have shown that if the stalks are not injured in the process of detasseling the yield will be as high or higher than it would have been if there had been no detasseling. But it is very difficult to detassel and not injure the plant at all, so the yield is usually lower on the detasseled corn than on the other. The only value of detasseling is that it makes out of the plants that are detasseled females, while those that are not touched are both male and female. The ear on the female stalk has a known parentage on the mother's side. No other ears have a definitely known parentage.

The detasseling method is used where the breeding plot desires to get certain crosses. That is its only place of use. If it were attempted in a general field of corn the work connected with detasseling would cost more than any possible returns from any increased vigor of the plants.

The method of detasseling is simple. Just at the time that the tassels are appearing walk through the rows. Wherever there is a tassel long enough to be caught by the tip, take hold of it and by a quick pull upwards remove the entire tassel. At this stage the parts of the corn plant are easily broken and so the tassel comes out with the least damage to the rest of the plant. Do not use a knife. This will injure the plant more than any other method. It is often advised to detassel the barren stalks. That advice would be all right if the barren stalks could be told at the time when the detasseling should be done. But the fact that the ears may appear later on the stalk makes such advice worthless.

An Example of Experiment Station Breeding.

The experiment stations all over the country have done more or less work with corn, but it is all somewhat alike in methods followed. The state of Illinois has worked out a system that has more details and which combines the best principles that are used elsewhere. They have found that the protein content, and the fat content can be more or less controlled by breeding, and their efforts to work out a system for this and at the same time for preventing inbreeding has much of interest. They outline the work in Bulletin 100 from their station.

Size of the Breeding Plot.

From our present knowledge we believe that 96 ears is a safe number to use, so far as in-breeding is concerned, and this is the number that we suggest in these directions, it being understood that alternate rows are to be detasseled and all seed corn selected from detasseled rows.

Plant by the Row System.

The 96 selected ears are planted in 96 separate rows. These rows should be at least 100 hills long, but they may well be forty rods long, as the amount of seed will usually permit this.

It is recommended that these 96 seed ears be numbered from 1 to 48 and from 51 to 98, the numbers 49 and 50 being omitted; also that ears 1 to 48 be planted on one-half of the plot and ears 51 to 98 be planted on the other half, preferably end to end with the first half, leaving one hill unplanted to mark the line between the two halves, also leaving one row unplanted to mark to line between rows 24 and 25 and between rows 74 and 75; that is, between quarters.

In this way row 51 (planted from ear 51) is a continuation of row 1 (planted from seed from ear 1) and the two rows may well extend 80 rods across a forty acre field. The breeding plot can be planted with a corn planter, although it will require some time and patience, and if the planter is an edge drop it will be necessary to put a suitable cone or inverted funnel in each box so as to keep the small amount of corn to the outside. Place the shelled corn from ear number 1 in one box and from ear No. 2 in the other; drive to the middle line of the plot, thus planting rows 1 and 2; clean out the boxes; move forward one hill; put in corn from hills 51 and 52; use the foot trip until the corn begins to drop, then drive on and plant ears 53 and 54; plant back to the middle; clean out, put in ears 3 and 4, then plant on back to the beginning line, thus continuing until the breeding plot is all planted. The planting may be continued for the commercial field using the same variety of corn, which could be of similar breeding, finishing, perhaps, with the multiplying plot on the opposite side of the field from the breeding plot.

Each one of the breeding plot rows should be numbered to correspond with the register number of the ear from which it is planted.

The breeding plot should be well protected from the foreign pollen, by being planted as far away from other varieties of corn as possible.

Selection of Field Rows and Seed Ears.

As the crop matures, the corn from each detasseled breeding row is now harvested. First all the ears on the row which appear to be good seed ears and which are borne on good plants, in good position, and with good ear shanks and husks, are harvested, placed in a bag with the number of the row, finally weighed, together with the remainder of the crop from the same row. No seed ears should be taken within two or three rods of the inside ends of the rows. The total weight of ear corn which every detasseled row yields should be determined and recorded, for the yield is the primary factor in determining the rows from which all of the seed ears for next year's seed selection must be taken. Each lot of ears from each of the detasseled rows, and finally each single ear of the 96 seed ears ultimately selected is kept labeled with the number of the row in which it grew and finally with its own ear number also, and permanent records are made of the number and the description of the ear, the performance records of the row, etc., so that as the breeding is continued an absolute pedigree is established on the female side, for every ear of corn which may be produced from this seed so long as the records are made and preserved. We also know absolutely that we have good breeding on the male side, although the exact individual pedigree of the males cannot be known and recorded.

Planting for Cross-Pollination.

In order to insure cross breeding to the greatest possible extent the plan given in table eight should be adopted.

Table 8.—Plan for Planting the Breeding Plot to Avoid Inbreeding.

The numbers given in the guides designate the field rows from which the seed ears are taken. (All even numbered rows are detasseled.)

Field Row No.	Guide System for Even Years	Guide System for Odd Years	Model Example for an Even Year	Field Row No.	Guide System for Even Years	Guide System for Odd Years	Model Example for an Even Year
1	76	78	76	51	2	4	4
2	2	2	4	52	52	52	52
3	80	82	84	53	6	8	10
4	6	6	10	54	56	56	58
5	84	86	90	55	10	12	16
6	10	10	16	56	60	60	66
7	78	76	80	57	4	2	8
8	4	4	8	58	54	54	56
9	82	80	86	59	8	6	14
10	8	8	14	60	58	58	60
11	86	84	92	61	12	10	20
12	12	12	20	62	62	62	68
13	78	76	80	63	4	2	8
14	2	2	4	64	52	52	52
15	82	80	86	65	88	6	14
16	6	6	10	66	56	56	58
17	86	84	92	67	12	10	20
18	10	10	16	68	60	60	66
19	76	78	76	69	2	4	4
20	4	4	8	70	54	54	56
21	80	82	84	71	6	8	10
22	8	8	14	72	58	58	60
23	84	86	90	73	10	12	16
24	12	12	20	74	62	62	68
25	52	54	52	75	26	28	30
26	26	26	30	76	76	76	76
27	56	58	56	77	30	32	36
28	30	30	36	78	80	86	84
29	60	62	66	79	34	36	42
30	34	34	42	80	84	84	90
31	54	52	56	81	28	26	34
32	28	28	34	82	78	78	80
33	58	56	60	83	32	30	38
34	32	32	38	84	82	82	86
35	62	60	68	85	36	34	46
36	36	36	46	86	86	86	92
37	54	52	56	87	28	26	34
38	26	26	30	88	76	76	76
39	58	56	60	89	32	30	38
40	30	30	36	90	80	80	84
41	62	60	68	91	36	34	46
42	34	34	42	92	84	84	90
43	52	54	52	93	26	28	30
44	28	28	34	94	78	78	80
45	56	58	58	95	30	32	36
46	32	32	38	96	82	82	86
47	60	62	66	97	34	36	42
48	36	36	46	98	86	86	92

In this plan the breeding plot is considered by quarters. Each quarter contains 24 rows and each row is planted with corn from a separate seed ear. All even numbered rows are detasseled and seed for the next year's breeding plot is taken from the six best yielding detasseled rows in each quarter, four ears being taken from each selected row, making 96 ears in all.

For convenience we use the term "sire seed", or "sire ears", to designate the ears which are to be planted in odd-numbered rows to produce tassels (the male flowers) and to furnish pollen; and we use the term "dam seed" or "dam ears" to designate the ears to be planted in the even rows to produce future seed ears. Of the four seed ears taken from each selected field row, two are used for sire seed and two for dam seed.

In the column headed "Guide system for even years" is given a key or guide, by which to work out the actual plan for planting in all even numbered years, under the heading "Model example for an even year" is given an actual plan which has been worked out, using four seed ears from six selected rows from each quarter of the breeding plot.

In the guide system, for the sake of simplicity, we use four seed ears from each of the first six even-numbered rows in each quarter, a selection which would probably never occur in actual practice.

It will be observed that the dam seed ears for each quarter are ears which grew in the same quarter. For the first quarter (rows 1 to 24) sire ears are brought from the fourth quarter. For the second quarter, sire seed is brought from the third. In each of these cases sire seed is carried diagonally across the breeding plot. For the third quarter sire seed is brought from the first quarter, and the fourth from the second, the sire seed being carried lengthwise of the breeding plot in these cases.

It will also be observed that there is a definite order of planting for "even years" and another definite order for "odd years." Thus, in the first quarter, the even-numbered rows are planted in ascending order with dam seed selected from rows numbered: 2, 6, 10, 4, 8, 12, 2, 6, 10, 4, 8, 12.

The alternating even numbers are repeated in sets of three and six. The odd numbered rows are planted with the sire seed selected from rows numbered: 76, 80, 84, 78, 82, 86, 78, 82, 86, 76, 80, 84.

This is the same order as for the dams except that the two sets of three are reversed in the second set of six. The only change required for odd numbered years is to transpose the two sets of six in planting the sire seed. Exactly the same system is used in each quarter of the breeding plot.

Arranging Seed Ears for Planting.

By referring to the "Model example for an even year" it will be seen that it becomes an easy matter to follow the "Guide System" in arranging seed ears for planting. Suppose, for example, that in 1905 the best six rows in the first quarter of the breeding plot are 4, 8, 10, 14, 16, 20. Then, for the dam seed for planting the first quarter in 1906 these numbers in ascending order, are to be substituted for the numbers 2, 4, 6, 8, 10, 12, which are given in the "Guide System."

Thus: For 2, substitute 4; for 4, substitute 8; for 6, substitute 10; for 8, substitute 14; for 10, substitute 16; for 12, substitute 20.

Arranging these for planting the field rows, we have:

Row No.	Guide System.	Actual Plan
2	2	4
4	6	10
6	10	16
8	4	8
10	8	14
12	12	20
14	2	4
16	6	10
18	10	16
20	4	8
22	8	14
24	12	20

If the best six rows in the fourth quarter of the 1905 breeding plot are 76, 80, 84, 86, 90, 92, then for the sire seed for planting the first quarter in 1906 these numbers are to be substituted in the regular order for the numbers 76, 78, 80, 82, 84, 86, which are given in the "Guide System". Arranging these by threes as indicated

in the "Guide System", we have the order for planting the odd numbered rows in the first quarter: 76, 84, 90, 80, 86, 92, 80, 86, 92, 76, 84, 90.

Thus we have both the dam and the sire seed ears for the first quarter arranged exactly as shown under the heading "Model example" in Table 8. The seed ears are arranged for each quarter of the breeding plot in a similar manner by following the "Guide System" and substituting in regular ascending order the actual numbers of the best yielding rows for the numbers given in the "Guide System" in Table 8.

It will be seen that with this selection of best rows, as given in this "Model example," we would take the four best ears from row No. 4 (1905) and plant two as dam ears in rows 2 and 14 and the other two as sire ears in rows 51 and 69 (1906); we would take the four best seed ears from row No. 84 (1905) and plant two as dam ears in rows 78 and 90 and the other two as sire ears in rows 3 and 21 (1906).

In arranging seed ears selected from the 1906 breeding plot for planting the 1907 breeding plot, we are to follow the "Guide system" for odd numbered years, again returning to the system for even-numbered years for 1908.

Multiplying Plot.

Seed for a multiplying plot of ten acres or more should be taken only from the selected rows of the breeding plot, and may include all good seed corn which is not required for the breeding plot. This seed should be well mixed together and planted on the multiplying plot. The corn grown in the multiplying plot should be carefully protected from foreign pollen and all inferior stalks should be detasseled. The exact yield of the multiplying plot should be determined and registered.

Commercial Field.

The seed for the commercial field should be only the best obtainable seed corn from the multiplying plot. The exact yield of the commercial field should be determined and registered. From the

commercial field the finest ears may be selected and sold to the trade as pedigreed seed corn.

In Other States.

This has been a quotation from the state of Illinois. Other states have done work similar in many respects. Illinois probably entered the field with systematic work, but the results that have been obtained there are no greater than have been obtained in the states of Ohio, Indiana, Iowa, Kansas, Nebraska, etc. We say "no greater" and yet there has been in no other state a piece of experimental work to compare with the high and the low protein breeding that Illinois developed. Dr. Cyril G. Hopkins is responsible for this great work. In commenting on what has taken place at the Illinois station and what may be done by the farmer on the farm, he says:

> To the practical corn breeder I would urge only three things:
>
> 1. Adopt the row system; plant 20 to 40 good seed ears, one to a row; then select your seed for next year, on the basis of personal record, from about ten rows which produce the highest yield and the best ears.
>
> 2. Breed corn for a purpose. If you wish to feed corn, breed and grow high protein corn. If you wish to grow corn for the starch and glucose factories, breed and grow the corn the factories want.
>
> 3. Until we have more facts, do not devote too much time to the "fancy points," such as trying to grow kernels at the tip end of the cob, or trying to reduce the size of the cob, or trying to make the tip end of the cob as large as the butt, or pulling out suckers, or doing other things the ultimate end of which is unknown. It is not yet known with any degree of certainty whether such things are beneficial, injurious, or without effect on the production of the crop.
>
> And do not feel that you cannot breed corn even if you are unable to detassel barren stalks. Last year we had fields with fifty per cent of barren stalks; this year the same fields have about five-tenths of one per cent of barren stalks, and these examples fairly illustrate the tremendous effect of soil and season and conditions of growth, as compared with breeding, upon the production of barren stalks. Barren stalks bear

no seed ears, and the whole tendency of nature's law is to breed them out, and even without the intervention of man. As a matter of fact, in order to give barren stalks an equal chance with the ear bearing plants to propagate themselves, we should be obliged to detassel every ear-bearing plant in the field. In studying this problem it should be borne in mind that the female parent of the barren stalk was not barren.

It is probably more important that we absolutely prevent self-pollination and close pollination by detasseling alternate rows, but even this practice is still an experiment.

Since Dr. Hopkins spoke these words Illinois has given their sanction to the practice of detasseling to secure cross pollination, where that work is done by men who know what they are about.

By the Stations

The best data that will indicate what is being done by the workers in corn breeding is that of the varieties produced. And yet that indicates only in part what has been accomplished and in comparing the station with the seed houses and the individuals who are responsible for new market types it must be held in mind that the stations probably spent far more time and care than any of the others in doing seemingly the same work.

The stations have produced varieties only within the last few years for the reason that the work was little understood before that time. And then at that time of new soils and unexplored sections of the country there was little expression of need on the part of the farmers. The experiment stations always try to fill the immediate needs of the farms of their section. The Illinois corn is called Illinois High Protein, or Illinois High Oil as the case may be, and these indicate the new varieties. Minnesota has brought out two varieties. The first, Minnesota No. 13 has a fame all through the west and north where a quick maturing dent corn is desired. After this was produced the need for a still shorter maturing corn was felt and the second, Minnesota No. 23, was the result. Wisconsin has taken the old Silver King and adapted it to the Wisconsin conditions of climate and soil and we have what is known as Wisconsin No. 7. Before many years there will not be a state in the union but will have a corn that distinctly represents the country where grown. In fact no one can expect to grow a universal corn.

By Seed Houses.

Much as may be said about the methods of the seed houses the fact that they have produced new varieties speaks well for their work. It is a little difficult to find what they have done, for in many cases they are listed under the name of the man who did the work. Only three of these firms will be mentioned here. There are many more. Funk Brothers of Bloomington, Illinois, have been breeding corn for a number of years, and they have various strains that go on the market under their names. Henry Field, of Shenandoah, Iowa, has improved several of the common varieties of corn but still uses the old names. He advertises White Elephant, and Corn Planter along with the standard varieties. W. A. Wheeler, of the Dakota Improved Seed Company, Mitchell, S. D., has one variety known as Early Murdock which has done well around the parts of the state of South Dakota where it is sold.

By Individuals

But by far the greatest work in bringing out new varieties of corn has been done on the farms by men who saw ahead a little farther than their neighbors did. Silver King, that white corn which does so well in some of the northern states was originated by H. J. Goddard, of Fort Atkinson, Iowa. Early Mastodon which is now quite widely distributed was originated by C. S. Clark, of Huron County, Ohio. Nimms Brothers of Emerson, Iowa, produced the now famous Legal Tender. Silver Mine was started by J. H. Beagley, of Sibley, Illinois, but has since that time been changed not a little by other workers. Leaming, a corn that has been very popular in the corn belt, took its name from J. S. Leaming, of Wilmington, Ohio, who originated it. The history of Reid's Yellow Dent is known to everyone. Boone County White, Riley's Favorite, Golden Eagle, White Superior, Shenandoah Yellow, Pride of the North, Farmers' Reliance, Chase's White Dent, McAuley White Dent, Golden Row, Nebraska White Prize, Iowa Ideal, Willhoit, Cattle King, Kansas Sunflower, Hildreth Yellow Dent, and a score of other common types have received their names and their worth from the individual corn breeder on the farm.

How to Keep These Varieties Pure.

This heading suggests a problem, especially if the farmer who is attempting the job lives in a thickly settled community. There is one prominent breeder who thinks so much of the purity of his corn that he will not allow his neighbors to plant corn of any other variety. He furnishes them with their seed corn every year rather than have them raising other corn, and since he has such fine corn they are willing to follow his advice. But it is just about as difficult to keep the strains of corn pure as it is to keep the weeds away from the farm, if your neighbor takes no interest in the same work. The only way to overcome such difficulties is to organize, which is the way that the business man has of accomplishing his purposes.

There would be several objects to such an organization in connection with the securing of good seed corn. In the first place the corn might be regulated by some central farm where men who have had a great deal of experience would be located, and then at this same farm there might be conducted experiments that would prove of value to all. There is no better example in the United States, at the present time, of what can be done by co-operation than that given in the work of the Wisconsin Experiment Association. This association is formed of students of the Agricultural college but the practices might well be applied anywhere. When the organization was started the objects were to keep pure bred seed in the hands of those men who knew how to handle really good material, to help all members in touch with the other members so that seed might be sold from any member to anybody else at any time. The story is briefly told by the report of the secretary, R. A. Moore:

> Our Experiment Association was organized February 22d, 1901, and now has a paid membership of about 1500. We probably have a working membership of 1800. A person must have been a student in the College of Agriculture in order to be eligible to the Experiment Association. We do not take in the rank and file of farmers as we feel that it is necessary to have young men who have received instruction along the line of best methods for the growing, curing, and shipping of all seed grains.
>
> The Experiment Association receives state aid and while it co-operates closely with the College of Agriculture, yet it is no integral part of the College, only as a co-operative body. We are now receiving $2,000 annually from the state and the state

also prints 5,000 of our reports at a cost of about $1,800. We have no paid officers in our association with the exception of the last two years the members set aside a small sum for the secretary. The first eight years of its existence, however, no funds were paid to any officers whatever, and the money is used wholly for purchasing seed, grains, etc., for co-operative work.

We have arranged with the Experiment Station so that all pure bred pedigreed seeds which are grown on the Station Farm can be purchased and controlled by the Experiment Association. These seed grains are sold to the association at the regular market price of common grains. In turn the Experiment Association agrees to establish seed grain centers and sell at a moderate figure to farmers and seedsmen of the state the pure bred pedigreed seed grains. Under no conditions does a member of the Association dare charge more than twice the regular price of common grains for the select seed grain. For instance, if oats were worth sixty cents a bushel on the general market, a member would not dare charge more than $1.00 per bushel for his select oats, etc., all along the line. In this way we have been able to establish pure bred grain centers in every district and township in the state, so that the farmers will have near at hand a place to purchase grains that will yield from 5 to 10 bushels more per acre than the common varieties handled.

While our first attempt was merely to supply the farmers of the state, we now find that the members of the Experiment Association are supplying parties all over the United States. Seed grains are being shipped to New York, Massachusetts, Pennsylvania and California. A shipment of 5000 bushels of pedigreed barley was just made to Montana and we now have an order for forty bushels of Golden Glow Corn from Russia. Last year the Experiment Association not only sold to parties in the United States but they had a trade with Mexico, Japan, China, Austria and the British Isles. We estimate that the Experiment Association members sold $500,000 worth of seed grains last year.

The value of this work comes mainly in the fact that the farmers who ally themselves with the movement either as members or as buyers receive great benefit, because they are dealing with, planting, and studying pure bred grains. The work that has been done in the state of Wisconsin with the corn would repay for all of the labor, but at the same time that that work is being handled small grains are bringing equally large returns. There is no reason why

a member of this college could not get better results with his corn than his neighbor is getting if he will put forth the effort.

Conclusion on Breeding of Corn

Corn is a plant that must itself be studied if the improvement desired is to be accomplished. The same practices that are followed with other crops are not followed with corn, at least they should not be. The corn plant may be varied at the desire of the breeder, but in doing that he should be careful that self and close pollination are prevented, for the plant protests against that form of mating. There should be a consistent idea in the mind of the breeder as to the purpose for which the corn is expected. This purpose should not change without sufficient consideration. Breeding for a purpose will bring profit, and if that work is placed in an organization of farmers which has for its business the marketing and improvement of grains it will be recognized for all that it is worth.

SOME PRACTICAL FARM USES OF THE CORN CROP.

There are many, but it is not the attempt here to mention all of them. Just a few of those which have proven of value on many farms but against which there seems to be a prejudice on some other farms. It will be noted that in the first case cattle are interested, in the second hogs are of value, in the third sheep, and in the last, man himself receives the first and direct benefit.

The Silo.

Why it is that in some sections there seems to be such a great prejudice against the silo is more than the enthusiast in its support is able to figure out. It may be because it is a new feature to farm life. I say it is a new feature to farm life for the reason that on many American farms the subject had never been considered until the pasture began to get short in some of these dry years. But as a matter of fact the silo has been in use for a good many years, not exactly in the same form that we see it today, but the idea of keeping green material in a fresh condition by keeping the air away from it

PLATE 17.—Ideal condition s for the dairy. A cement silo is shown at the right.

was used. In times past holes were made in the ground for the preservation of material of this kind.—

The essentials of a good silo are few but they are essential. The first one is that it be air tight. Not long ago a letter came from a man in a corn belt state asking if there would not be some benefit in making the silo with ventilation at the bottom. There should be no ventilation whatever. If there is, the whole object of the work is turned aside, for the secret of keeping the green corn is in preventing air from touching it. So the silo must be air tight except for the top. Second it should be of sufficient height to allow the silage to pack well therein. For the silo of average circumference the height should be about thirty feet. Then the silo should be smooth on the inside. The objection to the square silo lies in the fact that the silage is not able to settle as well in it as in the round form. The silage cannot be placed back in the corners very well. One man in Wisconsin whose work has come under the writer's attention made the square corners on the inside round by filling in with extra lumber. He claimed an advantage to this in the fact that he could build to the side of the silo where it was square. It should be remembered however, that the purpose of the silo is for silage, and that mission should not be sacrificed for any other convenience. As to the material out of which a silo should be built there is much discussion. It is the best opinion, however, that there is little need for worry on the point of material, providing the other points are watched. There are successes in stave silos, in cement silos, in hollow block silos, and in most other kinds. The failure usually comes when some of the work of filling it is neglected.

Filling is a matter of experience. Special machinery is needed for the work. No estimate of the expense can be given that would apply to all sections, but the expense is not large. The silage cutter will usually cut the stalks in pieces about 2½ to 3 inches long. These go up to the top of the silo by a carrier, and then comes the important work. It is assumed that the corn is cut from the field just as the lower leaves are beginning to turn yellow. If the corn is harvested later than that it will be necessary to add water to the cut material. As the silage is run into the silo it will fall in one place and if left there for any length of time will settle in a very unsatisfactory manner. So it is necessary to have within the silo during the operation one man, or two men if possible, who shall see to it

PLATE 18.—A typical dairy barn with stave silo at one end. No dairy can run efficiently without the silo.

that the silage is well distributed all of the time. One farmer expresses it by saying that he likes to have his silage kept the shape of a saucer ready for the cup. That is, hollowed a little near the center. And all of it should be tramped very thoroughly. Too much care cannot be given this point. Of course it will be seen that this job is not an easy one, and it will require proficient help.

After this is done there is no need for further work. It does not matter whether there is a roof on the silo or not. The top of the silage will spoil anyway and must be removed when the time for feeding comes. Careful feeding on good silage will pay. This applies especially to cattle. The Dairy farm that goes without the silo is not making the money that is possible for it to make. It is a little outside of our province to suggest how to feed the silage but the experience of men where ever dairy cattle are raised give testimony to the fact that it is profitable if fed judiciously, and there is good testimony coming from all of the forms of live stock to this same effect.

Hogging Down Corn.

The turning of the hogs to the corn is becoming more and more used in sections where heretofore all of the corn was thoroughly husked and fed to the stock in their pens. That speaks for its desirability and profitableness. Some farmers claim that this method is a slovenly one and in a way it is, but the returns come more quickly and the farm looks as neat as where other methods are followed. So the practice cannot be criticised very strongly. The following figures will indicate somewhat the profitableness of the method of hogging down the corn. They are given by Mr. C. A. Waugh, of Columbus, Ohio.

Without counting the value of the manure, or the cost of the labor saved in feeding the 175 pigs that were fed by him, the accounts look as follows:

175 pigs cost	$ 967.00
14 tons of ear corn at $1 cwt.	280.00
15 acres of clover; $15 per acre.	225.00
5 acres wood pasture, at $10.	50.00
12 acres of corn, 35 cwt. per acre; 55c per cwt.	231.00
Total expense.	$1,753.00

PLATE 19.—Filling a silo is not an easy task, but if the corn is brought to the cutter in bundles the work is greatly facilitated.

135 hogs, 208 lbs, at $8.40, less shipping expense	$2,260.29
32 hogs, 168 lbs., at $8.00.	448.80
2 hogs, 160 lbs., at $8.00.	25.60
Total receipts.	$2,734.69
PROFIT.	$ 981.69

Some of the pigs were on hand from the farm breeding, but others were bought. All were figured in at the cost of those purchased. The method of feeding included ear corn and clover as well as the field corn. Mr. Waugh further figures that the following values must be taken into consideration:

Gain, saved on labor.	$ 75.60
Value of excrement.	108.00
Which would make a total profit of	$1,166.29

There are many turns that shorten labor. It seems as if this way of feeding some of the corn is one of those turns. The greatest waste occurs where there is too much land turned over to the hogs. In the above work six acres were given to the hogs at a time. When that was used the other six acres were turned over to them. These figures certainly are suggestive, and are worth the study.

Lambs in the Corn Field.

This is a new form in the feeding business, but it is successful especially where lambs may be bought from the market at a reasonable price. For this work it is necessary to think ahead of time. About the time of the last cultivation of the corn rape should be sown. This will grow rapidly for there is no crop on the farm that develops in so short a time as rape. When it is time to turn in the lambs the rape will be just right.

The lambs should be given access to the field just after the silks have done this work year after year. The lambs will eat off the silks, they will clean the field of weeds, and the rape goes to make the feed that much more balanced. The lambs will find all the feed that they can use for quite a while just off of the weeds, the lower leaves of the corn plant, the silks, and the rape. When it seems best

to teach the lambs to eat the ear corn turn in a few old ewes. They know what the ear corn is and how to get it, and it will be but a few hours until the younger generation will be after the ear corn in just the right way.

This is another great saver of money in harvesting the corn crop. All that is necessary to finish the work of harvesting the crop is to run a drag or float over the field to lay the rest of the corn flat, and the sheep will do the harvesting. The field is left in the very best condition for working the next season.

Seed Corn a Specialty.

This heading brings up a question that deserves more and more attention as the commercial world becomes more and more complex. This is a day of specialization. You have heard that before, and in some places the idea is followed so closely that folks are forgetting that other mortals live on the same land with them. But the fact remains that in all forms of endeavor the man who specializes is the man who wins. Let just a few examples suffice. The general store used to have the business because one could buy everything there. Today the special store is the one that gets the trade. Even where the large department store is organized for business it is equipped with experts in their lines so that the work is really specialized. The man who enters the field of engineering must be a specialist. It used to be that the general man could handle all sorts of jobs, but the field today is too large for that practice. The automobile engineer has his place and the farm engineer, but they have little time for thought along other lines.

To follow this a little further: The farmer that does not specialize does not get the most out of his opportunity. This does not mean that he is to raise one crop and only one. Such a practice would be ruin to the farm and to the farmer. But it does mean that there should be one feature about the farm that stands out as the best of the community, that will call the attention of the people to the farm and its products.

There is no specialty that appeals to everyone as generally as does the raising of pure bred seed corn for the commercial trade. There is no reason why this trade should be held in the hands of

the seed houses when all of the corn must be raised on the farms anyway. But if this specialty is followed extra work must be expected. It may be that that is the reason why so many farmers, in proportion to the total number, chose to follow in the footsteps left by the farmers of the past few decades and avoid specializing. It will mean advertising, and a lot of it. And advertising will call for better work, and better work will call for more advertising, and so the story will go until there is a trade established that is profitable beyond even expectations. This applies only to the man who works. One example: There is a community in Michigan where for a good many years no new practices were being introduced at all. Farms were running just as they had been running for years past. Many are still running that way. Suddenly there appeared on the scene a youth who, although he had been raised in the county, stood out from all of the others. Why? Because he was advertising seed wheat for sale, and he was selling it, too. Beside the road he raised some of the wheat. Every year it was a perfect field to look upon. Every year he sold more seed wheat. Finally he advertised that all of the seed wheat which he was selling was treated with formalin for smut. Then he installed a set of machines which took care of most of the seed grading done in the county. This meant advertising. He had to hire a regular stenographer. More and better work was required from him. Soon many of the Experiment Stations were testing the seed that he advertised, and that wheat was soon mentioned as one of the prominent varieties. And in the meantime he had become wealthy.

That sounds like a fairy story. Doesn't it? It is, but there are fairy stories like this being enacted everywhere that energy is added to work seasoned by brains. And the corn business has many a fairy story connected with it. Most of the men who originated varieties are examples. They saw what others did not see, and the profits came their way.

CONCLUSION.

After what has been said there are just a few remarks to be made by way of review. They are:

1. It pays to raise corn.
2. It pays to raise good corn.
3. It pays to raise your own good corn.

If you know what you are about.

EXAMINATION

NOTE TO STUDENTS.—These questions are to be answered independently. Never consult the text after beginning your examination. Use thin white paper about 6x9 inches for the examination. Number the answers the same as the questions, but never repeat the question. Mail answers promptly when completed.

QUESTIONS.

1. What is corn smut?
2. How is it transmitted from plant to plant?
3. Why will not formalin kill it?
4. Is smut of any value for food?
5. Is there very much danger in feeding it?
6. How much loss in corn is due to rust?
7. In what way is this like smut?
8. Describe the work of wire worms.
9. What is the main remedy?
10. How do the root worms destroy the yield of corn?
11. What symptoms will tell that the root worms are at work?
12. Explain the work and life of the cut worms.

13. Of what damage are root lice?

14. How may they be detected?

15. Name three other insects that work on the corn plant.

16. Where do they prevail?

17. How are they destroyed or prevented?

18. What insects affect the grain of corn itself?

19. What may be said of the relative importance of diseases and insects as related to the growth of the corn plant?

20. What is meant by breeding corn?

21. What about the plant of corn makes control of the breeding difficult?

22. What is the most common method of breeding corn?

23. What is meant by heredity?

24. By selection?

25. What is the unit of the work in corn improvement?

26. Why will not the kernel that is planted be expected to produce kernels just like itself?

27. Where should the breeding block be planted for best results? Explain.

28. What is the ear-to-row test?

29. How is it able to tell whether an ear is a high yielder or not?

30. Explain the use of the breeding and multiplying plots.

31. Is there an increased yield when two distinct varieties are crossed?

32. What is the reason for detasseling?

33. How is the work done?

34. }
35. } Explain in detail the work of the Illinois Experiment Station
36. } in breeding pure strains of corn.
37. }

38. What work have other stations done?

39. Where have varieties originated?

40. Name eight varieties and tell where they originated.

41. Name three benefits that might be expected from a farmers' organization which controlled the pure bred seed corn of a certain section.

42. What does it seem to you might be done by every farmer who raises corn, that his corn might be improved?

43. Explain the silo, as to its purpose and how that is accomplished?

44. What danger would there be in allowing air to enter the doors?

45. What are the points in filling that need special attention?

46. Is hogging down corn ever beneficial? Explain.

47. Wherein may the field of corn be of use to the lambs?

48. What are the essentials in the character of a man who wants to make a success of seed corn as a specialty?

49. What part would advertising play in the work?

50. Where would advertising pay, that is where would you advertise? Make out three advertisements for a farm paper, any one of which would answer your purposes if you were selling high grade seed corn each year.

WRITE THIS AT THE END OF YOUR EXAMINATION.

I hereby certify that the above questions were answered entirely by me.

Signed.....

Address.....

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